VOL. XX. No. 2 FEBRUARY 1935

MECCANO MAGAZINE

ROLLING ALONG — MODERN STYLE!
(see page 98)

6D.

HORNBY ELECTRIC & CLOCKWORK TRAINS

Fine fun on the line — with a Hornby!

You have spent many happy hours watching real trains at work. Now start a railway of your own and enjoy the thrill of operating Engines, Coaches, Wagons, Signals and Points on actual railway principles. It's the most fascinating pastime in the world!

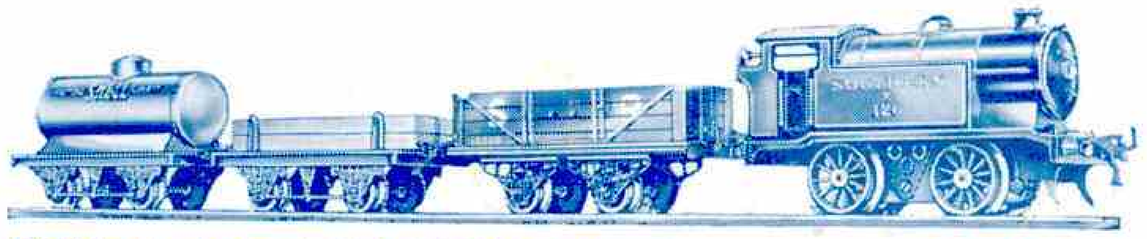
From the day of their introduction Hornby Trains have always represented the latest model railway practice. Designs are continually being improved and new items added so that the system is complete in practically every detail. There are Locomotives for all duties, driven by electric motors or by clockwork. There is Rolling Stock of all kinds including Pullman Cars, ordinary Coaches and Guard's Vans for passenger services, and numerous Wagons and Vans for freight working.

The Accessories are now better than ever before, while the Rails, Points and Crossings enable an endless variety of layouts to be constructed, both for Electric and Clockwork Trains.

Ask your dealer for a copy of the latest Hornby Train price list.

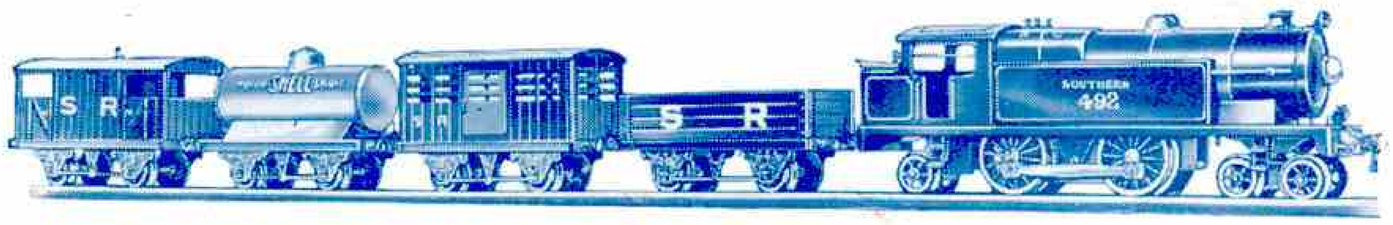
Manufactured by

MECCANO LTD.
Binns Road
LIVERPOOL 13

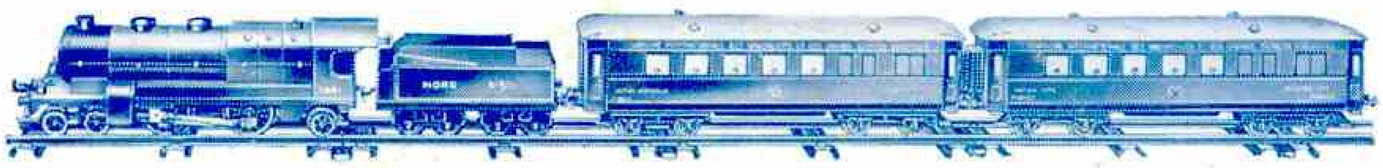


EM320 Tank Goods Set (20-Volt Electric) ... ... Price 24/-

Hornby No. 1 Passenger Set (Clockwork) ... ... Price 25/6



Hornby E220 Mixed Goods Set (20-Volt Electric) ... ... Price 47/6



Hornby No. 3C Riviera "Blue" Passenger Train Set (Clockwork) ... Price 58/6

Hornby No. E220 Special Pullman Set (20-Volt Electric) ... ... Price 75/-

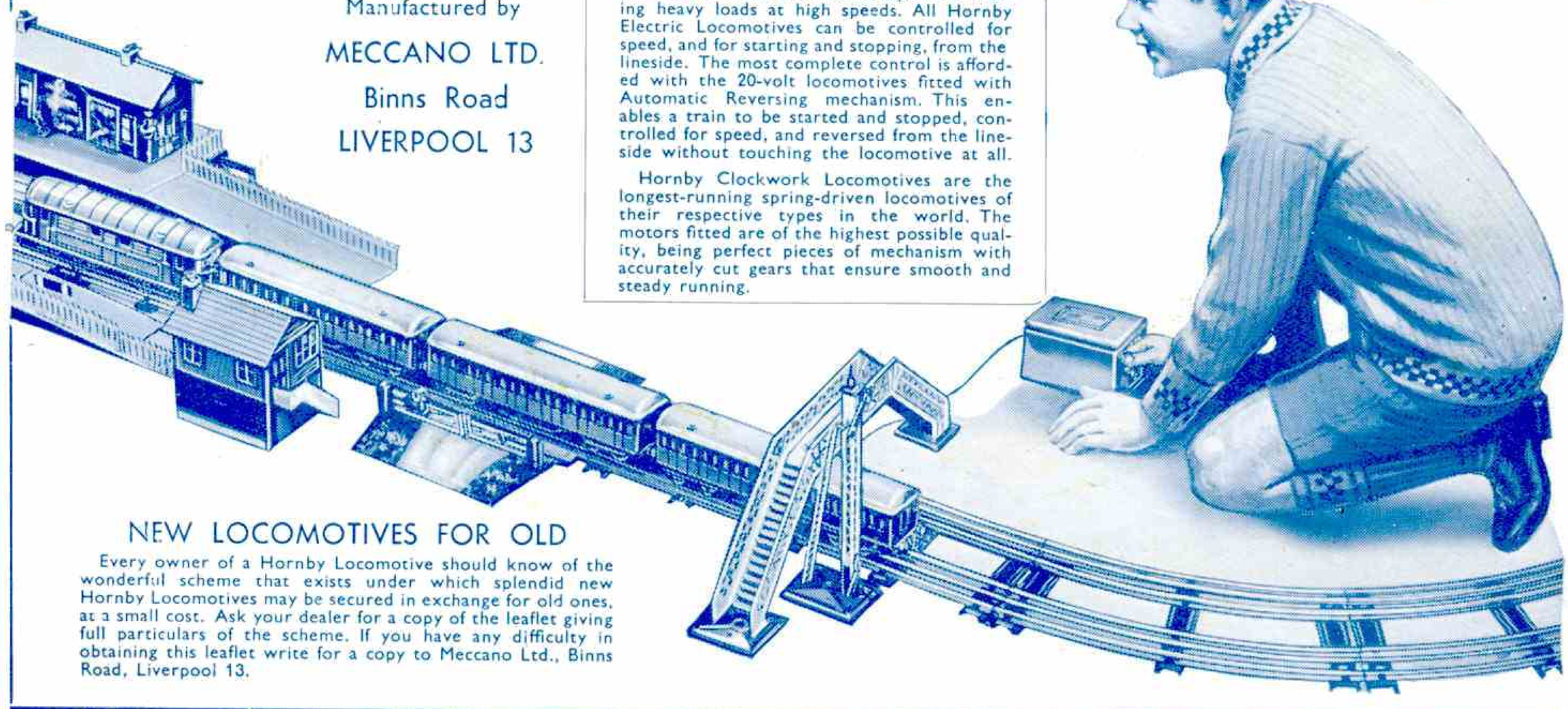
Prices of Hornby Electric Trains Sets from 15/- to 75/-
Prices of Hornby Clockwork Trains Sets from 4/11 to 65/-

HORNBY LOCOMOTIVES

Electric and Clockwork

Hornby Electric Locomotives are fitted with powerful and efficient motors capable of hauling heavy loads at high speeds. All Hornby Electric Locomotives can be controlled for speed, and for starting and stopping, from the lineside. The most complete control is afforded with the 20-volt locomotives fitted with Automatic Reversing mechanism. This enables a train to be started and stopped, controlled for speed, and reversed from the lineside without touching the locomotive at all.

Hornby Clockwork Locomotives are the longest-running spring-driven locomotives of their respective types in the world. The motors fitted are of the highest possible quality, being perfect pieces of mechanism with accurately cut gears that ensure smooth and steady running.



NEW LOCOMOTIVES FOR OLD

Every owner of a Hornby Locomotive should know of the wonderful scheme that exists under which splendid new Hornby Locomotives may be secured in exchange for old ones, at a small cost. Ask your dealer for a copy of the leaflet giving full particulars of the scheme. If you have any difficulty in obtaining this leaflet write for a copy to Meccano Ltd., Binns Road, Liverpool 13.

TRI-ANG

Many new and interesting lines are being shown at the British Industries Fair

MITCHAM

A fine Car for small children. Pressed steel body with Magna type radiator. Double crank drive. Steel disc wheels, enamelled in red with ½" white auto-tread tyres. Mudguards and running boards. Equipment includes adjustable windscreen, lamps, petrol and oil cans. Length 32 ins. **21/-**

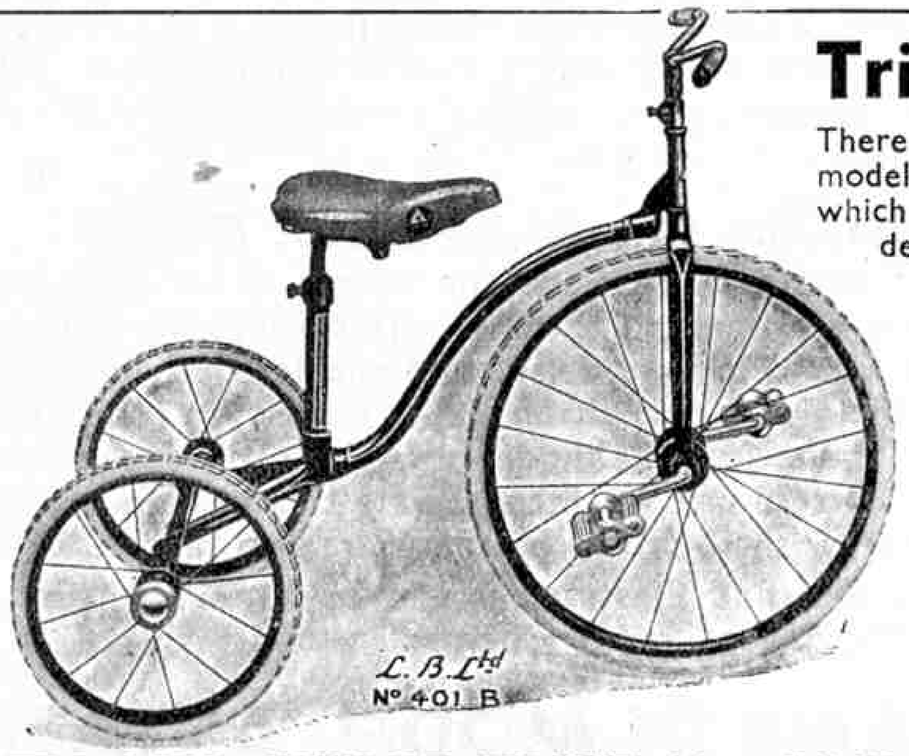
We make over forty different types of car, each of which is supreme in design, construction and finish.

WIMBLEDON

A sturdy Car with pressed steel body. Double crank drive and rubber pedals. Side opening door. Steel disc wheels and ½" white auto-tread tyres. Triumph type radiator. Finished in blue enamel with scarlet wheels. Length 31 ins. **17/6**

Tri-ang Trikes

There are twenty-five different models of Tri-ang Trikes from which to choose. Ask your dealer for particulars.



TRI-ANG JUNIOR TRIKE No. 401B

Strong cycle tube frames, enamelled black, gold lines. Adjustable saddle. Thick white auto-tread tyres. Nickel plated fittings. **21/9**

TRI-ANG TRICYCLE No. 5

Cycle-chain drive with free wheel. Frame of best quality weldless cycle tubing. 14" wheels with 1¾" sponge tyres. Ball-bearing pedals. Coil-spring saddle. Finished black or blue cycle enamel, gold lines. Chromium fittings. **59/6**

Juvenile Cycles

JUVENILE CYCLE No. 9 (Boy's)

Frame of best quality weldless steel cycle tubing. Adjustable ball-bearings throughout, 16" x 1⅜" Dunlop pneumatic tyres on rustless tangent spoked wheels. Two rim brakes. Raised handlebars ½" x ⅛" cycle roller chain. Three coil saddle. Black or blue. Chromium plated fittings. **57/6**

GIRL'S MODEL same price

JUVENILE CYCLE No. 14 (Boy's)

18" Frame, for ages 8-12. Finest quality British tube. 18" x 1⅜" Dunlop pneumatic tyres. Three coil leather saddle. ½" x ⅛" roller chain. Ball-bearings throughout, two rim brakes. Free wheel. Black or blue. Usual bright parts Chromium plated. **59/6**

GIRL'S MODEL same price

ON SALE AT ALL GOOD TOY SHOPS, STORES, & CYCLE DEALERS **These prices are not applicable to Ireland**

Lines Bros. Ltd., Tri-ang Works, Morden Rd., London, S.W.19

SECRETS of SCALE MODEL AIRCRAFT DESIGN

4

The fourth of an interesting series of articles by the well-known designer responsible for the construction of the most perfect of all scale model aeroplanes, the "FROG" and "PUSS-MOTH"

The Use of the Gear Box in Scale Model Aeroplanes

Distributing the Weight of the Power Unit

One of the major problems in the successful design of FLYING Scale Model Aeroplanes is the power unit and the weight distribution of this power unit over the fuselage. Elastic is the most suitable material for the purpose, but it is not easy to get the required number of twists to make the model stay in the air long enough to make a flight.

How Non-Scale 'Planes are Designed

Non-Scale Models are made with long out-of-proportion fuselages and large airscrews, the airscrew having to act as a brake to prevent the elastic unwinding too quickly, as well as acting as a propelling force. But, not only is an aeroplane made in this way absurdly out of proportion with the wings in the wrong place—it is obviously wrong to have to use the airscrew as a brake.

The Problem Solved

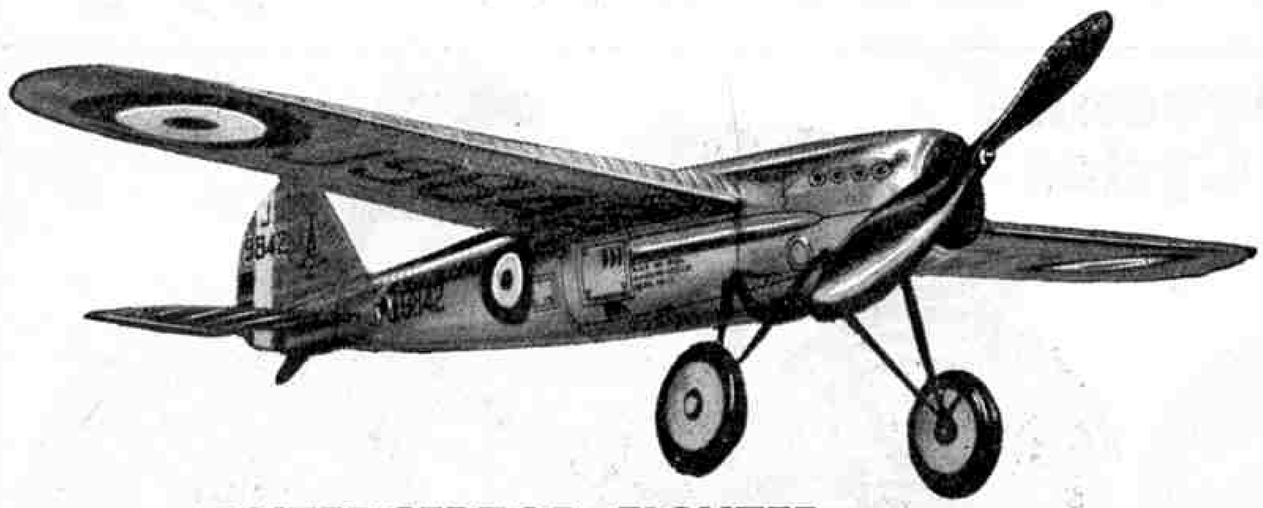
The designers of the "FROG" overcame *all* these difficulties by the use of the GEAR BOX and GEARED-UP MOTOR—Gear boxes have been used before but not the Geared-up Motor. This Geared-up Motor makes it possible to make the elastic motor much shorter because ONE TURN on the elastic gives approximately THREE-AND-A-HALF turns on the airscrew.

What the Geared-up Motor Does

The shorter motor and the weight of the gear box does three very important things. (1) It brings the weight nearer the nose of the aeroplane and enables the wings to be put in their proper position. (2) It makes the fuselage shorter and the exact scale model possible. (3) It enables a correct size airscrew to be fitted owing to the high speed of the airscrew shaft driven by the geared-up motor.

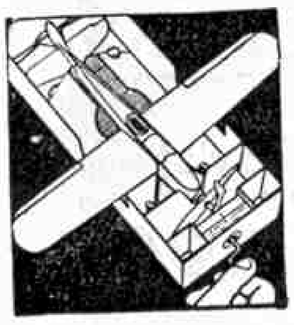
You will find illustrations and prices, with many details, of the "Frog" models below."

"FROG"—THE FOREMOST NAME IN MODEL AVIATION



INTERCEPTOR FIGHTER

A scale model of high-speed Monoplane. Tubular construction, patented quick detachable fittings. High efficiency airscrew. A popular machine for realistic stunting. The "Frog" is sold complete with spare motors, lubricant and gear-box oil, patent high-speed winder box and illustrated flying manual. Wing span 11½ ins. Flies 300 ft. Price **7'6**

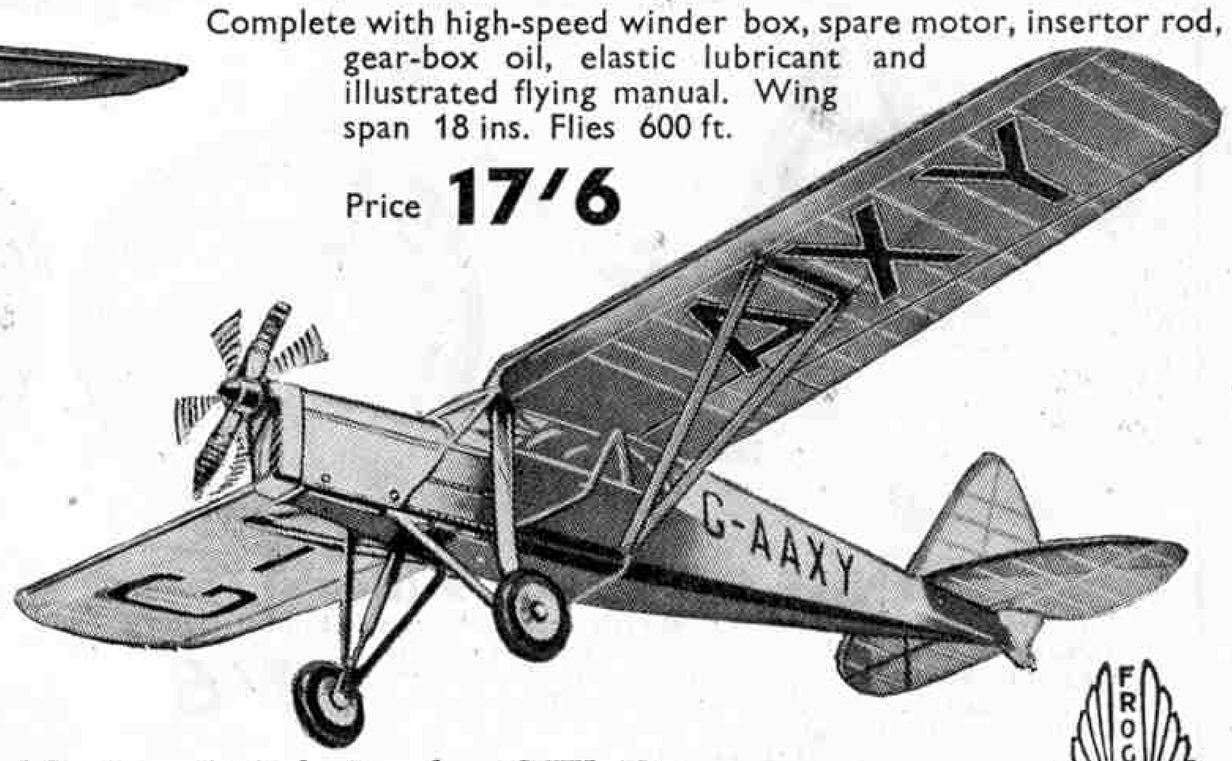


PUSS-MOTH MONOPLANE

A magnificent scale model of the famous record-breaking light aeroplane. All metal fuselage with bulk-head reinforcement, hollow wings of special design and construction. Dual motor-coupled gear box, transparent cabin and roof lights. "Frog" patent quick detachable fittings.

Complete with high-speed winder box, spare motor, insertor rod, gear-box oil, elastic lubricant and illustrated flying manual. Wing span 18 ins. Flies 600 ft.

Price **17'6**



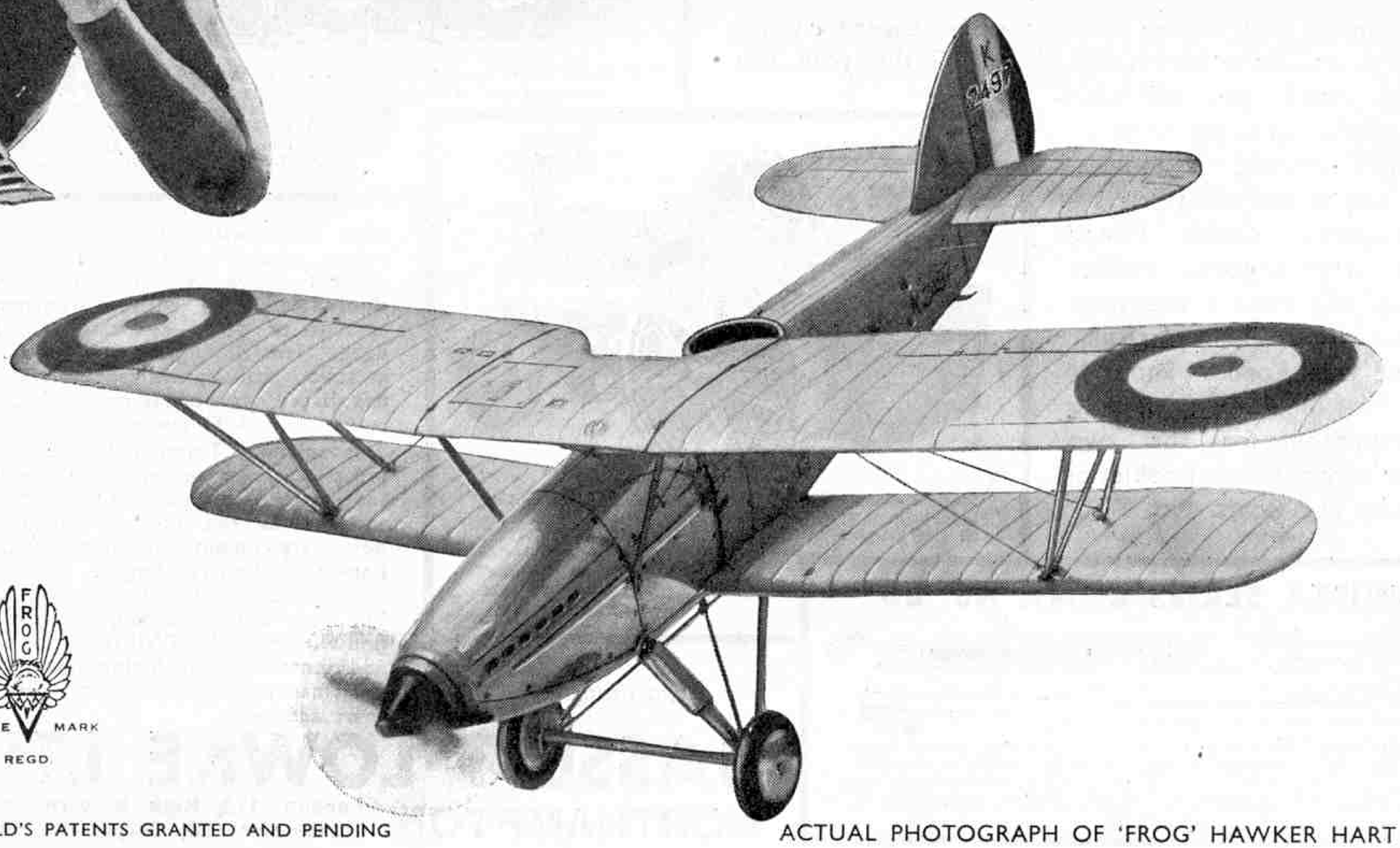
Designed and made by International Model Aircraft Ltd., London, S.W.19

SOLE CONCESSIONAIRES:

LINES BROS. LTD., *Tri-ang Works, Morden Rd., London, S.W.19*

FROG TRADE MARK REGD.

Seen the new HAWKER HART? It's made by the FROG people!



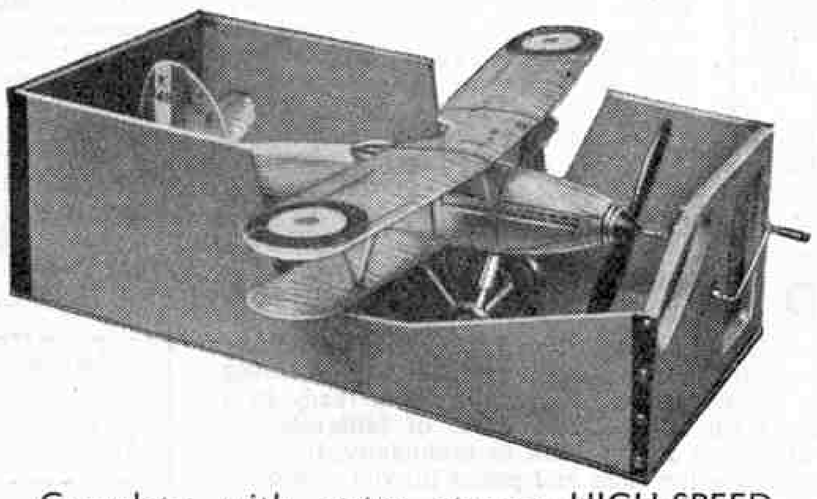
TRADE MARK REGD.

WORLD'S PATENTS GRANTED AND PENDING

ACTUAL PHOTOGRAPH OF 'FROG' HAWKER HART

The most famous military aeroplane in the world—the most formidable aerial weapon ever known—there's little need to tell you the name of the Hawker Hart. And now you may own and fly an almost exact reproduction in miniature of this wonderful fighter! The very latest 'Frog'—the flying scale model Hawker Hart—is waiting for you at your local shop to-day!

This 'Frog' Hawker Hart is designed (like the real machine) for short distance bombing. Every detail has been carefully considered to give complete realism to this wonder 'plane. There is actually a miniature Vickers-Scarffgun mounting ring before the observer's cockpit and a life-like instrument board in the pilot's cockpit. And the flying performance of this new machine is remarkable. Come and see the Hawker Hart now!



Complete with extra strong HIGH-SPEED WINDER-BOX, lubricant for Gearbox and motors, triple insertor rod, spare motors and profusely illustrated flying manual. **42/-**

SPECIFICATION

Telescopic spring-loaded under carriage. Unique fuselage built up on a reinforced structure of steel, duralumin and timber, covered either with aluminium, alloy sheet or a cellulose-paper—the only material capable o reproducing the exact form, shape and appearance of full-size aeroplane parts. Wings reinforced with internal ribbing and attached to fuselage with quick detachable fittings. Triple, 4-strand motor and watch type gearbox. Precision cut airscrew and spinner.

Wing Span, 18.75 ins. Overall Length, 15.36 ins.

Average Length of Flight, 700 ft.

Owners of a 'FROG,' PUSS MOTH or HAWKER HART are eligible for the handsome badges, price 6d. each, when the proficiency tests have been passed.

ON SALE AT ALL GOOD TOY SHOPS AND STORES

Made by INTERNATIONAL MODEL AIRCRAFT LTD., LONDON, S.W.19

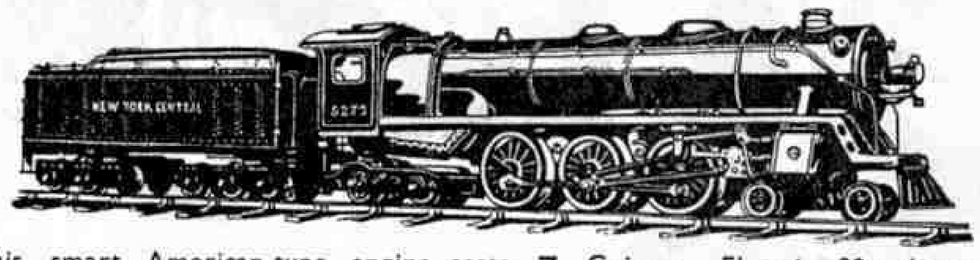
Sole Concessionaires: LINES BROS. LTD., *Tri-ang Works, Morden Road, Merton, S.W.*19

Rather! And I've already won my FROG Pilot Badge with it

THREE FASCINATING HOBBIES FOR BOYS

NOW in the dark winter evenings we are eager for something to do—let it be MODEL MAKING this year. Get Dad to start you off with one of the splendid array of BASSETT-LOWKE models. They can be had at all prices—Locomotives, Yachts, Motor Boats, and Engines, besides Fittings and Parts if you want to make your own particular model. Visit London Shop or send a penny stamp to Northampton for the two colour photogravure Booklet of Trains and Boats, No. 17.

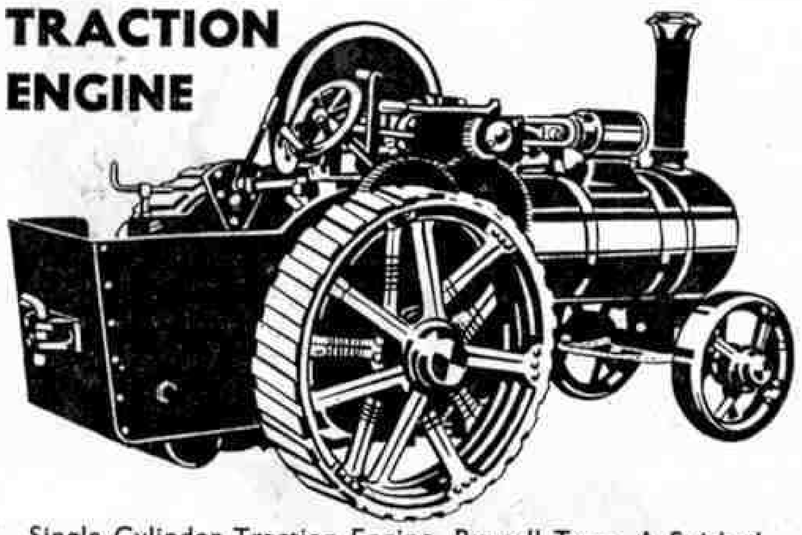
NEW YORK CENTRAL RAILWAY MODEL



This smart American-type engine costs **7** Guineas. Electric 20 volts a.c., reversing and starting from cab or track. Gauge O. *(Foreign.)*

● Just one example from A.17 MODEL RAILWAY CATALOGUE. Every boy will find something useful in this handbook and list combined. Over 150 pages (new edition), price **6**d.

TRACTION ENGINE



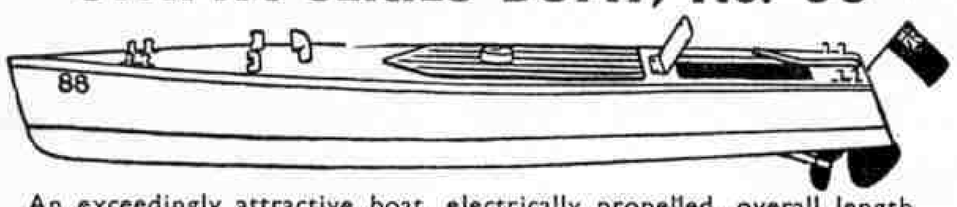
Single Cylinder Traction Engine, Burrell Type. A finished model of this magnificent engine costs **16** Guineas.

● One model from B.17 MODEL ENGINE CATALOGUE. A new edition. You will find this book an "open Sesame" for castings and materials. **6**d. post free.

Matt black with silver lining is the colour scheme of the fine American express above, which among other things, is fitted with a remarkable amount of detail—cow-catcher, headlights, imitation glass windows, and imitation coal on the tender, and will negotiate a curve of 3 ft. radius. Gauge O. A/C current.

This splendid Traction Engine should greatly interest readers. The complete set of castings and parts can be obtained, as well as the finished model. Full details are contained in the new Bassett-Lowke Stationary Engine List B.17, price 6d. post free.

SWIFTA SERIES BOAT, No. 88



An exceedingly attractive boat, electrically propelled, overall length 21 in. Beam 3¾ in. Price **21**/– from S.17 MODEL SHIP CATALOGUE.

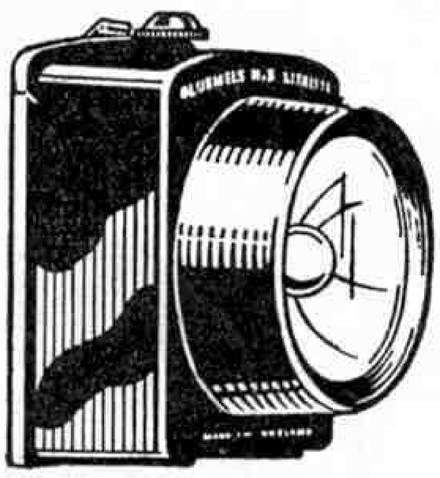
● Every ship lover will revel in the pages of this splendidly illustrated book on ships and ship models, written by engineers and naval experts. **6**d. post free.

The boy who likes Ship Models will find No. 88 of the SWIFTA series a fine addition to his fleet. Shining white enamel and bright fittings with a reliable permanent magnet motor labels this craft both smart and swift.

BASSETT-LOWKE LTD.

NORTHAMPTON London: 112, High Holborn, W.C.1 Manchester: 28, Corporation Street

Bluemels FOR SAFETY!

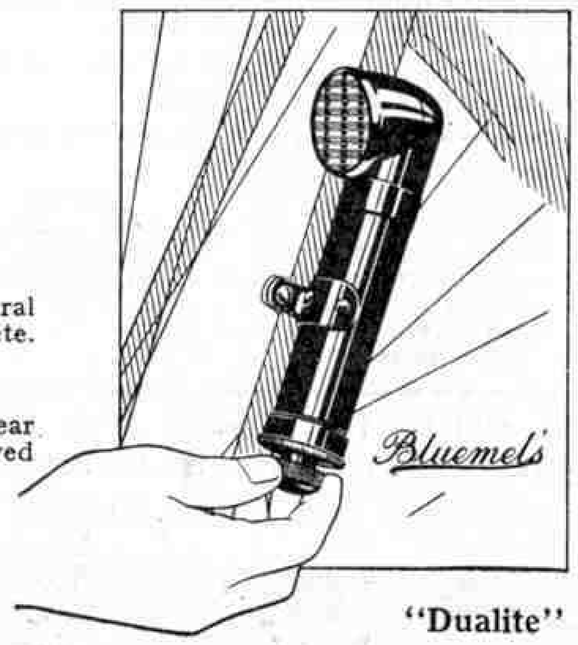


Here are two lamps both serviceable and handsome, of the latest type moulded construction. They are definitely proof against battery sulphation, and cannot corrode or rust. Most good dealers sell them.

No. 3 "Litalite"

No. 3 "Litalite" in black and several attractive colours, 3/6 complete. White 4/–.

"Dualite"—a novel combined rear lamp and red reflector of approved type. Can be used as either. Complete with battery, and low-consumption bulb, 3/6. White body 3d. extra.



"Dualite"

Fully illustrated list post free from

Bluemel Bros. Ltd., Dept. 27, Wolston, near Coventry.

NO HOME IS DULL that has a RILEY BILLIARD TABLE

8/- DOWN brings immediate delivery of a Riley "Home" Billiard Table. You pay balance as you play.

7 DAYS' Free Trial. Rileys pay carriage and take transit risks.

Hours of endless enjoyment may be spent on a Riley Billiard Table—enjoyment in which all the family can participate. Father, mother, boys and girls will be equally keen on this popular pastime. But it should be played on a REAL Billiard Table and not a toy. Play it on a Riley, every model of which is a perfect replica in construction of a full size Billiard Table. Sizes and prices of Riley "Home" Billiard Tables are shown below, also the easy monthly payments.

4 ft. 4 ins. × 2 ft. 4 ins.	...	£7	0	0	or in 20 monthly payments of	8/– 10/3 13/3 17/– 24/6
5 ft. 4 ins. × 2 ft. 10 ins.	...	£9	0	0		
6 ft. 4 ins. × 3 ft. 4 ins.	...	£11	15	0		
7 ft. 4 ins. × 3 ft. 10 ins.	...	£15	0	0		
8 ft. 4 ins. × 4 ft. 4 ins.	...	£21	10	0		

DINE AND PLAY ON THE SAME TABLE

The Riley "Combine" Billiard and Dining Table offers something unique in house furnishing, combining in one a beautiful dining table and a flawless billiard table. After dining, it is ready in a couple of minutes for a delightful game of billiards. Available in many attractive designs, oak or mahogany, for cash or on easy terms Here are the sizes and prices for the round leg mahogany pattern.

WRITE TO-DAY FOR ART LIST.

5 ft. 4 ins. × 2 ft. 10 ins.	...	£22	10	0
6 ft. 4 ins. × 3 ft. 4 ins.	...	£26	10	0
7 ft. 4 ins. × 3 ft. 10 ins.	...	£33	0	0
8 ft. 4 ins. × 4 ft. 4 ins.	...	£43	0	0

or in 13 or 20 monthly payments.

Rileys are the largest makers of full size Billiard Tables in Great Britain. Also specialists in accessories, re-covering tables, etc.

This is the Riley "Cabriole" design 6 ft. size, £34 10 0, or in 13 or 20 monthly payments.

E. J. RILEY LTD.

DEAL WORKS, ACCRINGTON

and Dept. 6, 147, Aldersgate Street, London, E.C.1

Hamleys News

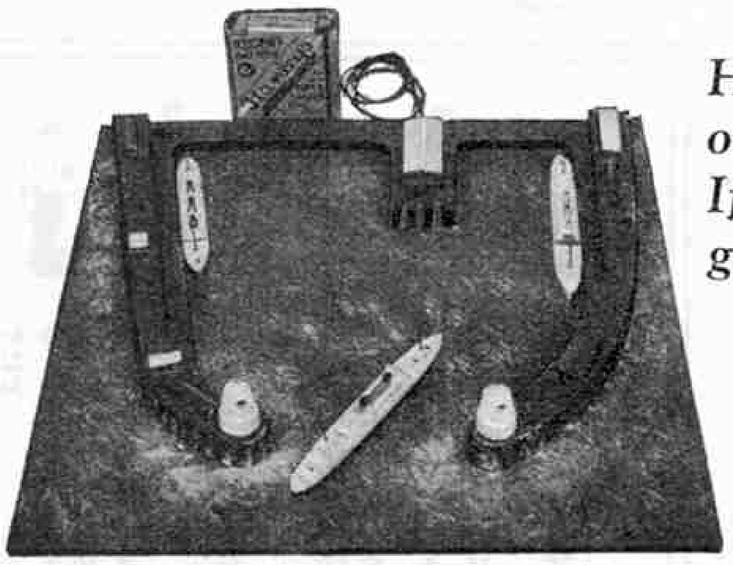
Estd 1760

·HAMLEY·BROTHERS·LTD

200-202, REGENT ST., LONDON, W.1

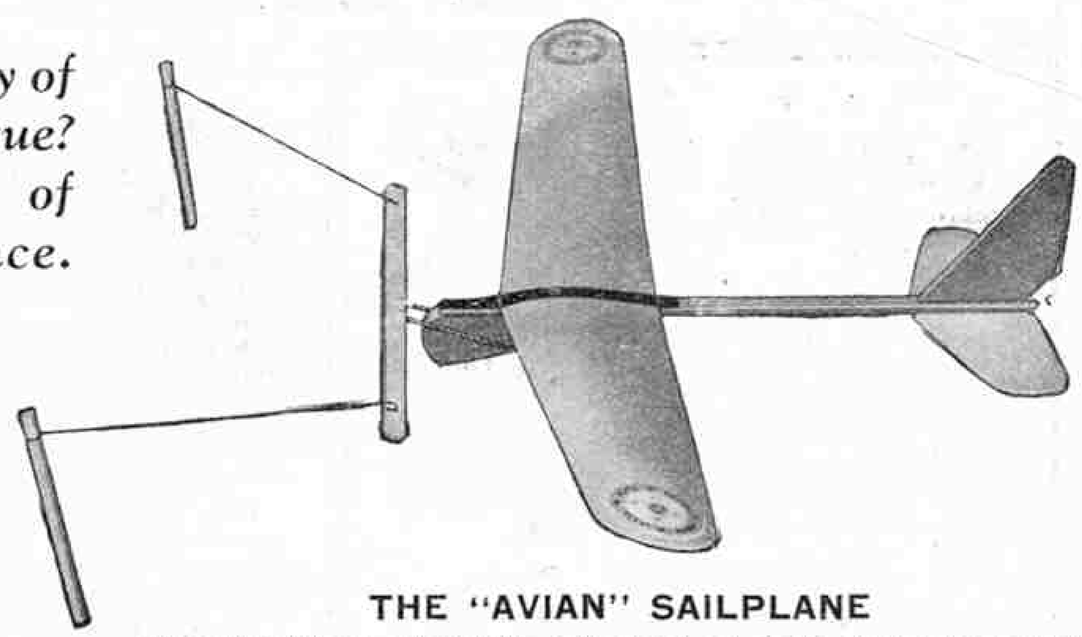
ONLY ADDRESS NO BRANCHES

Number Twenty-two *February, 1935*



Have you had a copy of our Annual Catalogue? If not, make sure of getting one at once.

POST FREE ON REQUEST



MODEL DOCKYARD

An exact model dockyard with electric harbour lights, operated with a 4½ volt pocket lamp battery. Price, including battery, **5/6**. Dinky toy ships, as illustrated in the harbour, per set of six, 3/6. The very thing to give a background to your waterline models. Postage 9d.

THE "AVIAN" SAILPLANE

"Avian" Sailplane, unbreakable, silver and red finish, curved wing which ensures lift. Real glider catapult. Wonderful flights. The only glider at such a low price which really glides and conforms to the principles of gliding. Price **2/6**. Postage 6d.

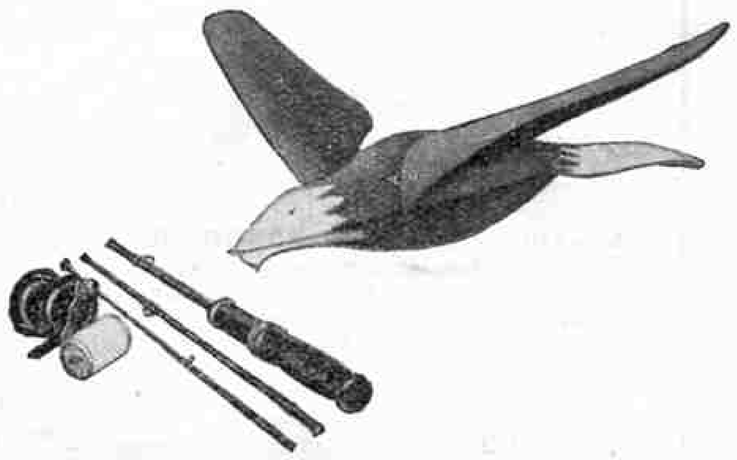
THE LATEST SPORT FOR BOYS
Better than Kite Flying

BENTURNER PARACHUTE

Every "Warneford" Flier should have one. The most ingenious parachute, for flying model aeroplanes. Silk chute, folds up into pack and is held to aeroplane by special release operated from elastic motor. When plane is at a height, release will allow parachute to fall and open. Price **2**/–. Spare chutes 1/–. Constructional set. Price 1/–. Postage 4d.

RIPLEY'S "BELIEVE IT OR NOT"

Ripley's of the "Sunday Express" Believe it or not. A complete set of well-known questions and answers. Turn the left-hand wheel to question, then rotate right-hand wheel until the red light shows, which will denote the answer. Price **5**/– (foreign). Eight sets of questions and answers, a fund of knowledge and amusement. Postage 9d.



"MISTRY" BIRD

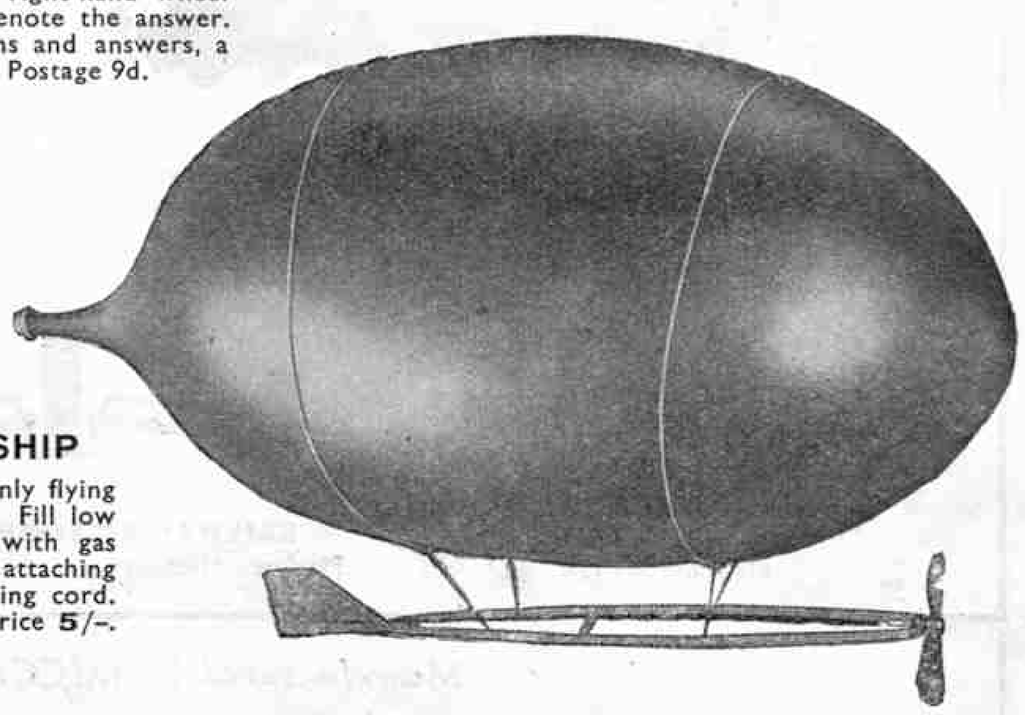
You must go Sky-Fishing with the "Mistry Bird," the new fascinating sport. You play your bird in the air with a steel fishing rod and line. The wings revolve and send it soaring into the sky. It may be taken out time and time again. Price complete with steel fishing rod, reel and line, as illustrated **25**/–.

SPEEDOMETER

Cooper Stewart Speedometer is suitable for all pedal cycles. Fitted with flexible shaft and front wheel drive, it will register accurately whether fitted to the right or left side of the machine. Easily fitted. Price **12/6** complete. When ordering, please specify whether for 26 in. or 28 in. wheel.

THE "AVIAN" AIRSHIP

"Avian" Airship, the only flying airship on the market. Fill low pressure rubber bag with gas (coal). Can hover by attaching ballast in form of hanging cord. Elastic driven motor. Price **5**/–. Postage 6d.



MECCANO

Toys of Quality

DINKY TOYS

The Best that you can buy

150 Varieties

Meccano Dinky Toys are the most realistic and the most attractive models in miniature ever produced.

One of the most important additions recently made is the scale model of the Cunard White Star Liner "Queen Mary" (Meccano Dinky Toys No. 52, see page VII). This is a magnificent model of the world's largest liner.

Many of these toys are ideal for giving the finishing touch to your model railways. You must have railwaymen to deal with your trains, and passengers to travel in them; car attendants to look after the passengers, and engineers for the maintenance of the railway and its equipment. You want farmyard animals for lineside fields, and you should have at least one of the famous "Hall's Distemper" advertisements alongside your line.

Then there are the miniature train sets, rail car and various other types of motor vehicle. You can have hours of fun running these on the table or on the floor, arranging road and rail transport services from one point to another.

These splendid toys can all be purchased separately at the prices shown, or they can be obtained in complete sets. Ask your dealer to show you the complete range of Meccano Dinky Toys.

Meccano Dinky Toys No. 1

STATION STAFF

No. 1a	Station Master	each 3d.
No. 1b	Guard	,, 3d.
No. 1c	Ticket Collector	,, 3d.
No. 1d	Driver	,, 3d.
No. 1e	Porter with bags	,, 3d.
No. 1f	Porter	,, 3d.

Price of complete set 1/6

Meccano Dinky Toys No. 4

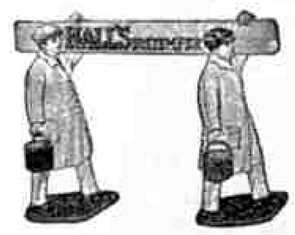
ENGINEERING STAFF

No. 4a	Electrician	each 3d.
No. 4b	Fitters (2)	,, 3d.
No. 4c	Storekeeper	,, 3d.
No. 4d	Greaser	,, 3d.
No. 4e	Engine Room Attendant ...	,, 3d.

Price of complete set 1/6

STATION OR FIELD HOARDING

This is a realistic accessory, suitable for model station platforms, or for fields adjacent to the railway track.
Price 6d.



Meccano Dinky Toys No. 13

HALL'S DISTEMPER ADVERTISEMENT

This miniature of a well-known line-side advertisement is intended to be placed in the fields adjoining a model railway track. Price 9d.

Meccano Dinky Toys No. 6

SHEPHERD SET

No. 6a	Shepherd ...	each 3d.
No. 6b	Dog	,, 2d.
No. 2d	Sheep	,, 2d.

Price of complete set 1/–

Meccano Dinky Toys No. 2

FARMYARD ANIMALS

No. 2a	Horses (2) ...	each 3½d.
No. 2b	Cows (2) ...	,, 3½d.
No. 2c	Pig	,, 2d.
No. 2d	Sheep	,, 2d.

Price of complete set 1/6

Meccano Dinky Toys No. 5

TRAIN AND HOTEL STAFF

No. 5a	Pullman Car Conductor ...	each 3d.
No. 5b	Pullman Car Waiters (2) ...	,, 3d.
No. 5c	Hotel Porters (2)	,, 3d.

Price of complete set 1/3

Meccano Dinky Toys No. 3

PASSENGERS

No. 3a	Woman and Child	each 3d.
No. 3b	Business Man	,, 3d.
No. 3c	Male Hiker	,, 3d.
No. 3d	Female Hiker	,, 3d.
No. 3e	Newsboy	,, 3d.
No. 3f	Woman	,, 3d.

Price of complete set 1/6

New items are constantly being added to the series of Meccano Dinky Toys, to increase the fun and fascination.

Meccano Dinky Toys No. 17

PASSENGER TRAIN SET

No. 17a	Locomotive	each 9d.
No 17b	Tender	,, 5d.
No. 20a	Coaches (2)	,, 7d.
No. 20b	Guard's Van	,, 7d

Price of complete set 2/3

Meccano Dinky Toys No. 18

GOODS TRAIN SET

No. 21a	Tank Locomotive	each 9d.
No. 21b	Wagons (3)	,, 4d.

Price of complete set 1/9

RAILWAY ACCESSORIES No. 7

Watchman's Hut, Brazier, Shovel and Poker. Price 1/3

Meccano Dinky Toys No. 19

MIXED GOODS TRAIN SET

No. 21a	Tank Locomotive	each 9d.
No. 21b	Wagon	,, 4d.
No. 21d	Petrol Tank Wagon	,, 6d.
No. 21e	Lumber Wagon	,, 5d.

Price of complete set 1/11

Meccano Dinky Toys No. 20

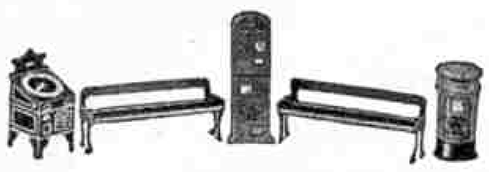
PASSENGER TRAIN SET

No. 21a	Tank Locomotive	each 9d.
No. 20a	Coaches (2)	,, 7d.
No. 20b	Guard's Van	,, 7d.

Price of complete set 2/6

RAILWAY ACCESSORIES No. 2

Milk Cans and Truck.
Price per set 1/3



RAILWAY ACCESSORIES No. 3

Platform Machines, etc. Price 1/6

RAILWAY ACCESSORIES No. 4

This set comprises all the pieces that are contained in Railway Accessories Nos. 1, 2 and 3. Price 3/9

RAILWAY ACCESSORIES No. 1

Miniature Luggage and Truck. Price 1/–

Manufactured by MECCANO LTD., Binns Road, LIVERPOOL 13

MECCANO

DINKY TOYS

Made of the finest materials

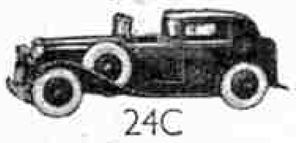
A fascinating collecting hobby

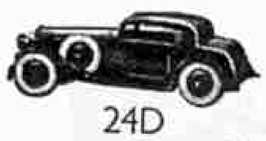
150 Varieties

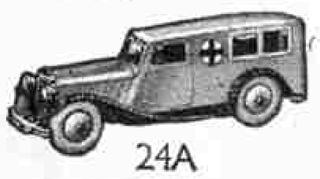
24E

24G

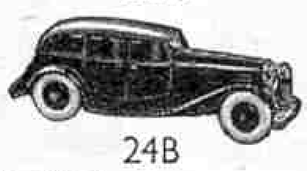
24F


24C


24D


24A

24H


24B

MOTOR CARS
Fitted with rubber tyres and silver-plated radiators.

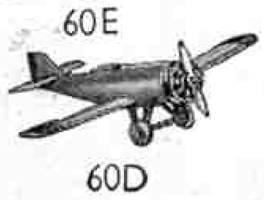
No. 24a	Ambulance	each	9d.
No. 24b	Limousine...	,,	9d.
No. 24c	Town Sedan	,,	1/–
No. 24d	Vogue Saloon	,,	9d.
No. 24e	Super Streamline Saloon	,,	9d.
No. 24f	Sportsman's Coupé ...	,,	9d.
No. 24g	Sports Tourer (4 seater)	,,	1/–
No. 24h	Sports Tourer (2 seater)	,,	1/–

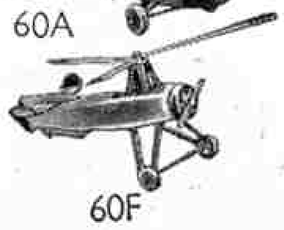
Price of complete set 6/6

60E

60A

60C


60D


60F

60B

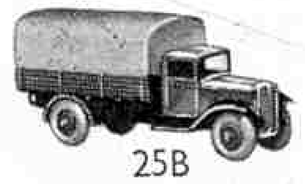
Meccano Dinky Toys No. 60

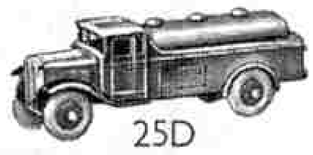
AEROPLANES

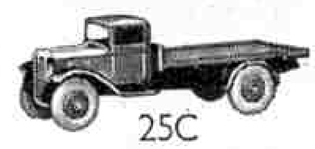
No. 60a	Imperial Airways Liner ...	each	9d.
No. 60b	D.H. "Leopard Moth" ...	,,	6d.
No. 60c	Percival "Gull"	,,	6d.
No. 60d	Low Wing Monoplane ...	,,	6d.
No. 60e	General "Monospar" ...	,,	6d.
No. 60f	Cierva "Autogiro" ...	,,	6d.

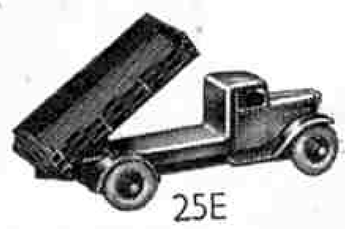
Price of complete set 3/–

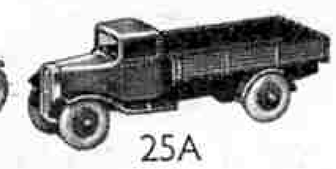
25F


25B


25D


25C


25E


25A

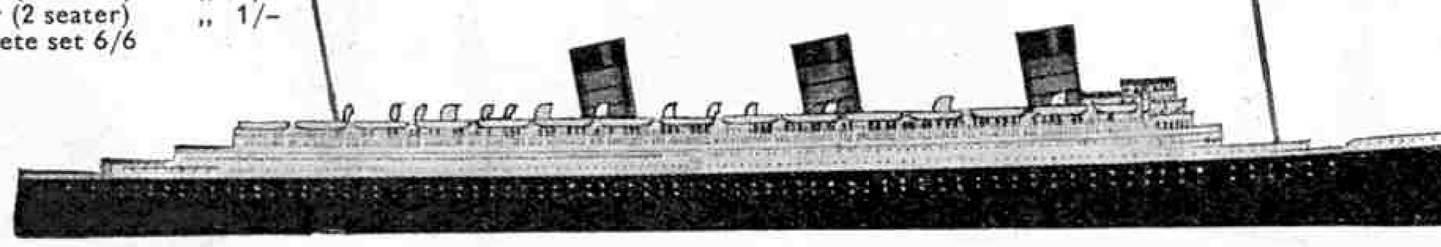
Meccano Dinky Toys No. 25

COMMERCIAL MOTOR VEHICLES
Fitted with rubber tyres and silver-plated radiators.

No. 25a	Wagon	each	9d.
No. 25b	Covered Van	,,	9d.
No. 25c	Flat Truck...	,,	9d.
No. 25d	Petrol Tank Wagon ...	,,	9d.
No. 25e	Tipping Wagon	,,	9d.
No. 25f	Market Gardener's Van ...	,,	9d.

Price of complete set 4/6

Finished in Bright Colours

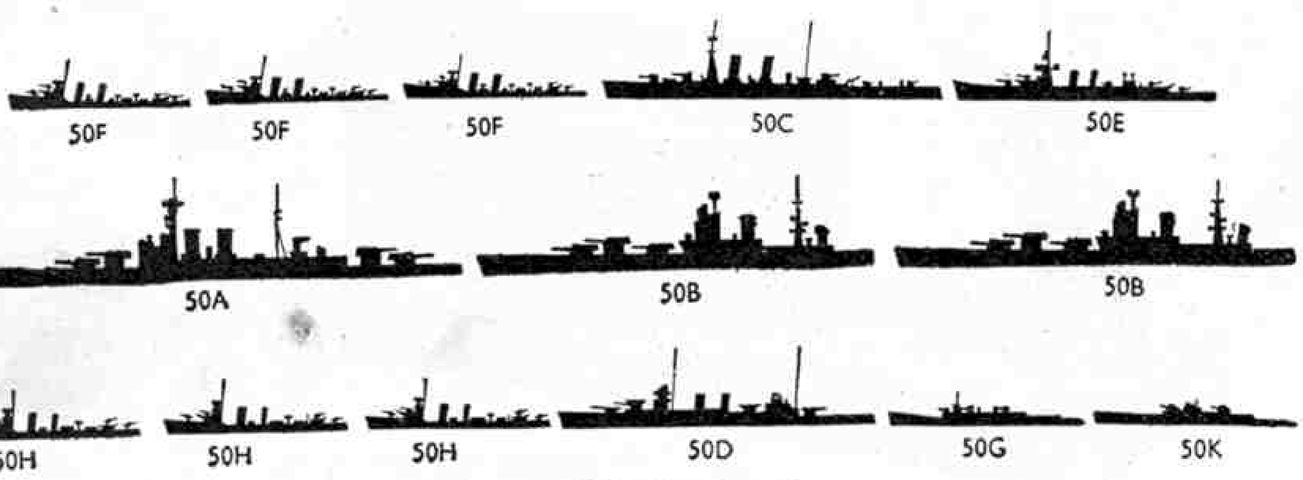


Meccano Dinky Toys No. 52 **CUNARD WHITE STAR LINER "QUEEN MARY"**
A scale model of the World's largest ocean liner. Price 1/– each

Meccano Dinky Toys No. 52a. Exactly as No. 52, but fitted with roller wheels. Price 1/– each

Realistic and Attractive Models

Meccano Dinky Toys No. 32
"AIRFLOW" SALOON
Assorted colours. Fitted with rubber tyres. Silver-plated radiator and bumpers.
Price 9d. each.


50F 50F 50F 50C 50E
50A 50B 50B
50H 50H 50H 50D 50G 50K

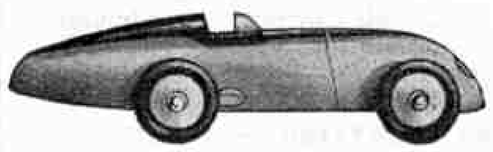
Meccano Dinky Toys No. 50

SHIPS OF THE BRITISH NAVY

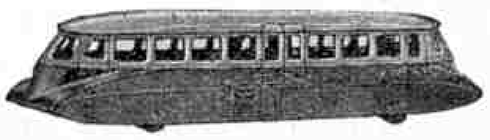
No. 50a	Battle Cruiser "Hood" ...	each	9d.
No. 50b	Battleships, "Nelson" Class (2)	,,	6d.
No. 50c	Cruiser "Effiingham" ...	,,	4d.
No. 50d	Cruiser "York"	,,	4d.
No. 50e	Cruiser "Delhi"	each	4d.
No. 50f	Destroyers, "Broke" Class (3)	,,	1d.
No. 50g	Submarine, "K" Class ...	,,	1d.
No. 50h	Destroyers, "Amazon" Class (3)	,,	1d.
No. 50k	Submarine, "X" Class ...	each	1d.

Price of complete set 3/6

Meccano Dinky Toys No. 31
HOLLAND COACHCRAFT VAN
Assorted Colours
Price 6d. each.



Meccano Dinky Toys No. 23
RACING CAR
Assorted Colours. Fitted with rubber tyres. Price 6d. each



Meccano Dinky Toys No. 26
G.W.R. RAIL CAR
Assorted Colours. Price 6d. each

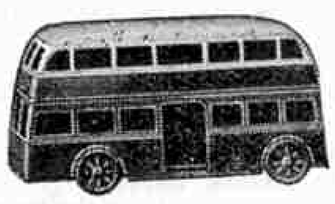
51C 51G 51B
51D 51F 51E

Meccano Dinky Toys No. 51

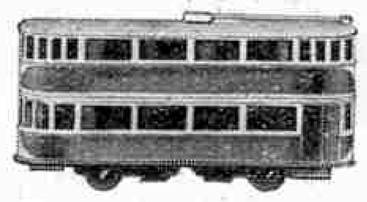
FAMOUS LINERS

No. 51b	"Europa"	each	9d.
No. 51c	"Rex"	,,	9d.
No. 51d	"Empress of Britain" ...	,,	8d.
No. 51e	"Strathaird"	each	6d.
No. 51f	"Queen of Bermuda" ...	,,	6d.
No. 51g	"Britannic"	,,	6d.

Price of complete set 3/6



Meccano Dinky Toys No. 29
MOTOR BUS
Assorted Colours. Price 6d. each



Meccano Dinky Toys No. 27
TRAM CAR
Assorted Colours. Price 6d. each

Manufactured by MECCANO LTD., Binns Road, LIVERPOOL 13

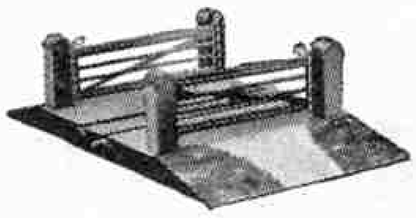
Hornby Series HORNBY ACCESSORIES Gauge O

There is a splendid range of Railway Accessories in the Hornby Series, built in perfect proportion and beautifully finished. With these realistic accessories the most elaborate model railway may be constructed and operated in exactly the same manner as a real railway. A selection of Hornby Accessories is illustrated below. Ask your dealer to show you the full range.

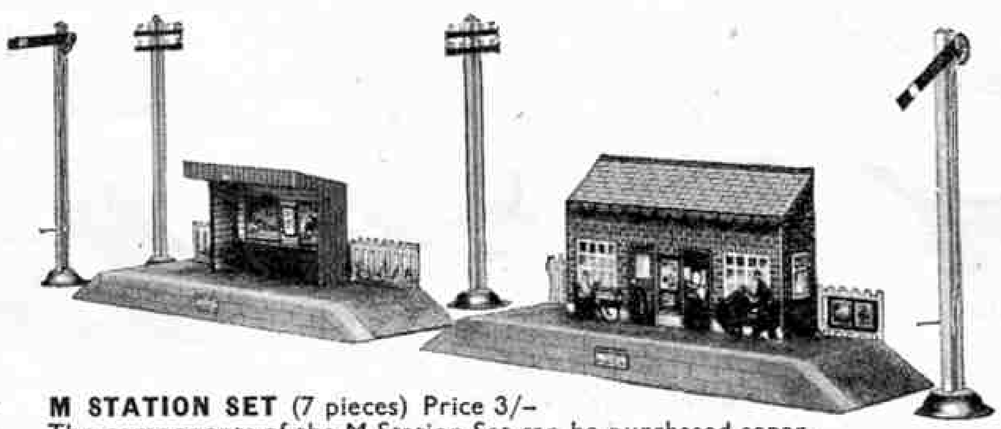
No. 1 SIGNAL CABIN
Price 2/9

STATION No. 2
Excellent model, beautifully designed. Built up in three detachable sections. Length 2 ft. 9 in., breadth 6 in., height 7 in. Price 9/6

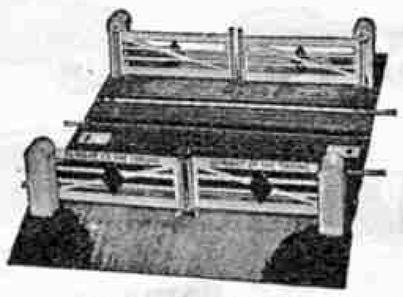
SIGNAL CABIN No. 2
Dimensions: Height 6⅛ in., width 3½ in., length 6½ in. Roof and back open to allow Lever Frame to be fitted inside cabin if desired.
Price 4/6



LEVEL CROSSING No. 1
Suitable for a single track only and has gauge O rails in position.
Price 2/11



M STATION SET (7 pieces) Price 3/–
The components of the M Station Set can be purchased separately as follows: M Signal Box. Price 4d.
M Signals. Price 4d. M Station. Price 1/–
M Telegraph Pole No. 1. Price 3d. M Wayside Station. Price 9d.



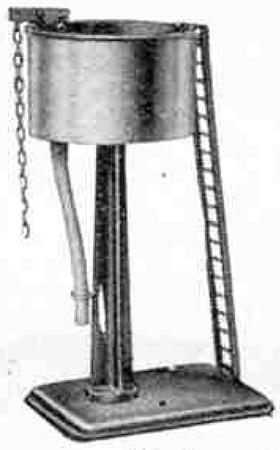
LEVEL CROSSING No. 2
Measures 13⅛ x 10¼ in., with two tracks of gauge O rails in position.
Price 5/6

LEVEL CROSSING No. E2 (Electrical)
Similar to Level Crossing No. 2 excepting that a third rail is fitted in each of the two tracks.
Price 7/6

TUNNEL No. 0 (Straight)
Length 6 in., width 6⅛ in.
Price 1/3

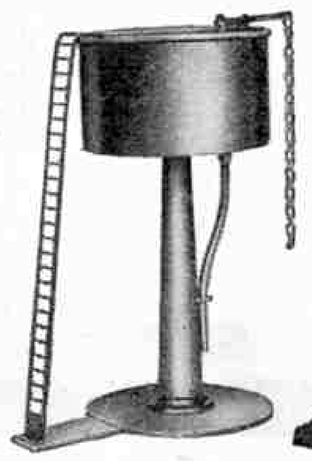
TUNNEL No. 1 (Straight)
Length 7 11/16 in. Width 6¼ in. (as illustrated).
Price 1/9

TUNNEL No. 2 (Straight)
Length 15⅝ in. Width 9½ in. Price 3/6



No. 1 WATER TANK
Fitted with flexible tube and valve lever. Stands 6½ in. high.
Price 3/–

No. 1 GOODS PLATFORM
Length 13 in., height 6¾ in., width 6 in.
Price 7/6

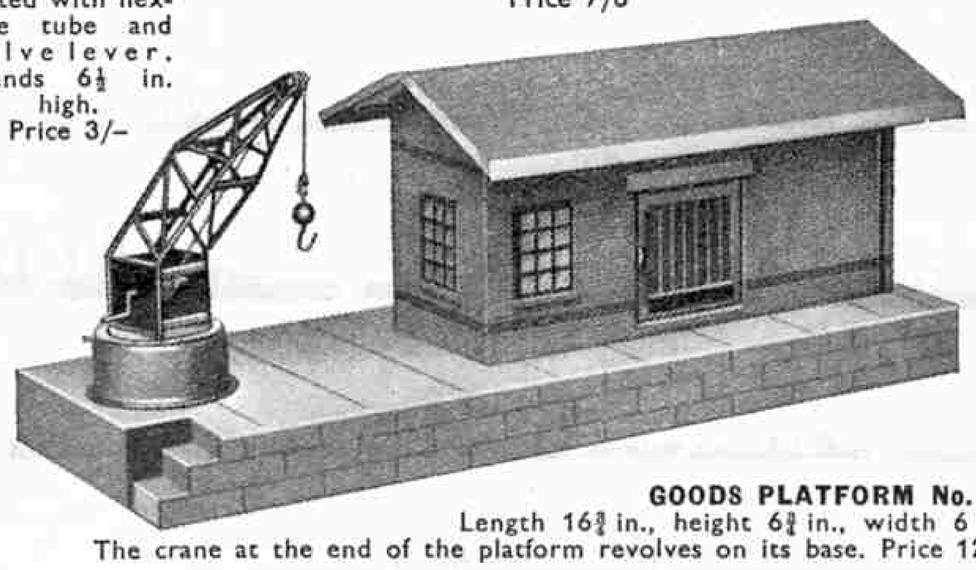


No. 2 WATER TANK
Fitted with flexible tube and valve lever. Stands 8½ in. high.
Price 5/9

CUTTING No. 4 (STRAIGHT)
This is a double cutting, mounted on a base over which the railway track is laid.
Base measurement: Length 15⅜ in., width 15 in. Price 6/–

TUNNEL No. 5 (LEFT-HAND CURVED)
(as illustrated)
This tunnel is in the form of a small hill, through which the track runs obliquely. For 2 ft. radius tracks. Base measurement: 15⅞ in. x 14⅜ in. Length of track 17¼ in. Price 6/9

TUNNEL No. 6 (RIGHT-HAND, CURVED)
Similar to No. 5 Tunnel, but with track in the reverse position. For 2 ft. radius tracks only. Base measurements 15⅞ in. x 14⅜ in. Length of track 17¼ in. Price 6/9



GOODS PLATFORM No. 2
Length 16¾ in., height 6¾ in., width 6 in.
The crane at the end of the platform revolves on its base. Price 12/6

Two No. 1 and one No. 2 Cuttings are illustrated here.

No. 0 CUTTING
This is a Double Cutting, similar in design to but smaller than Cutting No. 4. The base measurement is 8 1/16 in. square
Price 1/9

No. 1 CUTTING (End Section)
Base measurement: Length 7 1/16 in., width 6 in. Price, per pair 3/–

No. 2 CUTTING (Centre Section, Straight)
The addition of these centre sections enables a Hornby Railway Cutting to be extended to any length. They are intended to be used in conjunction with the End Sections (Cutting No. 1). Base measurement: Length 10¼ in., width 6 in.
Price 2/–

No. 3 CUTTING (Centre Section, Curved)
This is used for curved tracks in the same manner as the straight Centre Section, described above. is used for straight track. It is suitable for both 1 ft. and 2 ft. radius track. Price 2/–

TUNNEL No. 3 (Curved)
Length 13 in. Price 4/–

TUNNEL No. 4 (Curved)
(as illustrated)
Length 20 in. For 2 ft. radius tracks only. Price 4/9

LOADING GAUGE (illustrated) Price 2/3
M LOADING GAUGE Price 1/–

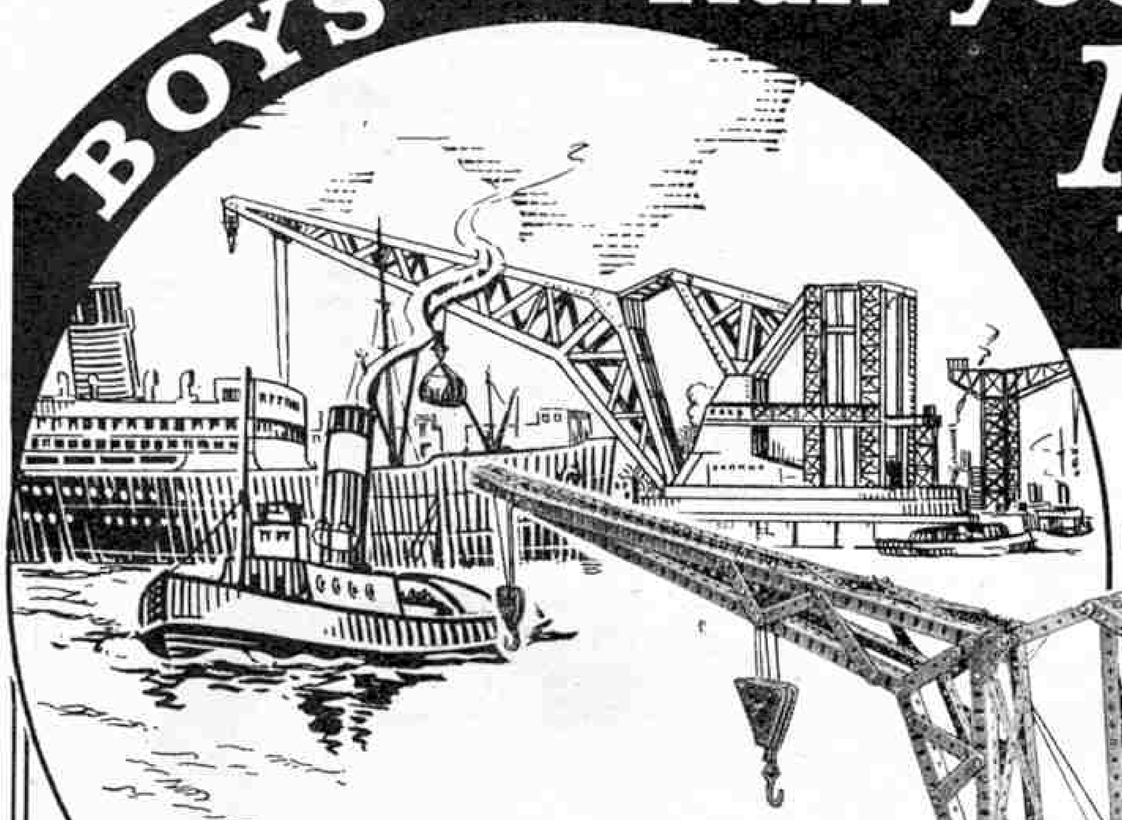
PLATELAYER'S HUT
Price 1/–

TURNTABLE No. 2
Price 3/9

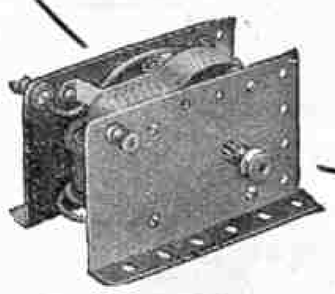
VIADUCT Price 6/6
VIADUCT Centre Section only ... ... Price 4/–
VIADUCT (Electrical) Price 7/6
VIADUCT (Electrical) Centre Section only ... ... Price 4/6

MECCANO LIMITED – BINNS ROAD – LIVERPOOL 13

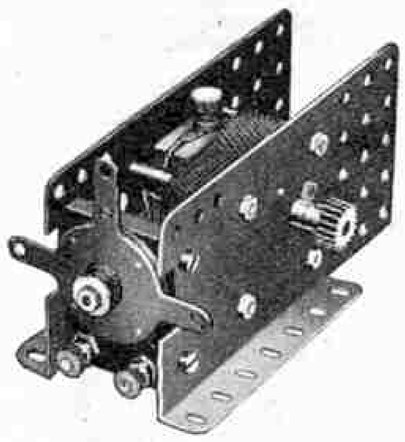
BOYS — Run your Models with a MECCANO POWER UNIT



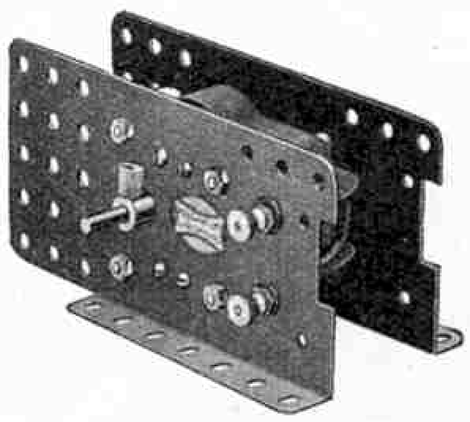
This splendid Meccano model of a Pontoon Crane is realistically operated by means of a Meccano Electric Motor



No. E1 Electric Motor (6-volt

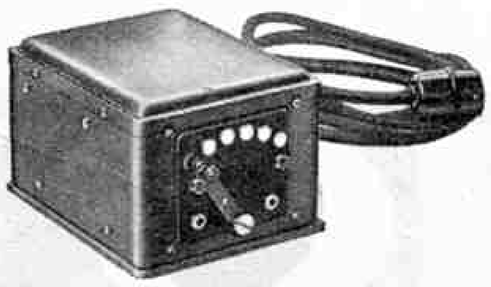


No. E6 Electric Motor (6-volt



No. E20A Electric Motor (20-volt)

Resistance Controller



No. T20 Transformer

If you want to obtain the fullest enjoyment from the Meccano hobby you should operate your models by means of one of the Meccano power units listed below. Each one is strongly made and the utmost care is taken in its manufacture to ensure that it will give entire satisfaction.

CLOCKWORK MOTORS

X Series Clockwork Motor. This non-reversing Motor is specially designed to drive models built with Meccano X Series parts ... ... Price 2/6
No. 1 Clockwork Motor. Non-reversing ... ... ,, 5/–
No. 1A Clockwork Motor. Reversing ... ... ,, 7/6
No. 2 Clockwork Motor. Reversing ... ... ,, 10/–

ELECTRIC MOTORS

No. E1 Electric Motor (6-volt). Non-reversing ... Price 9/–
No. E6 Electric Motor (6-volt). Reversing ... ,, 15/6
No. E120 Electric Motor (20-volt). Non-reversing ,, 10/–
No. E20A Electric Motor (20-volt). Non-reversing ,, 16/6
No. E20B Electric Motor (20-volt). Reversing ... ,, 18/6

It is important to note that the 6-volt Electric Motors cannot be run satisfactorily from dry cells.

ACCUMULATORS

6-volt 20 amp. hr. Accumulator for running 6-volt Meccano Electric Motors ... ... Price 27/9
2-volt 20 amp. hr Accumulator for converting a 4-volt accumulator to 6-volt ... ... ,, 9/3

RESISTANCE CONTROLLERS (6-volt or 20-volt)

By use of these Controllers the speed of Meccano Electric Motors and Hornby Electric Trains can be regulated as desired. Price (6-volt or 20-volt) 3/9

MECCANO STEAM ENGINE

Price 25/–

MECCANO TRANSFORMERS

A Meccano Transformer provides a means of driving a Meccano Electric Motor or Hornby Electric Locomotive from the mains where this is alternating current. There are six Transformers in the series, all of which are available for the following A.C. supplies: 100/110 volts, 50 cycles; 200/250 volts, 50 cycles; 225/250 volts, 50 cycles. Any of these Transformers can be specially wound for supplies other than the above. When ordering a Transformer the voltage and frequency of the supply must always be stated.

No. T6 Transformer (Output 25 VA at 9 volts) for 6-volt Electric Motors and Locomotives. Fitted with speed regulator. Price 17/6

No. T6M Transformer (Output 25 VA at 9 volts) for 6-volt Electric Motors and Locomotives. This is similar to No. T6, but is not fitted with a speed regulator ... ... Price 12/6

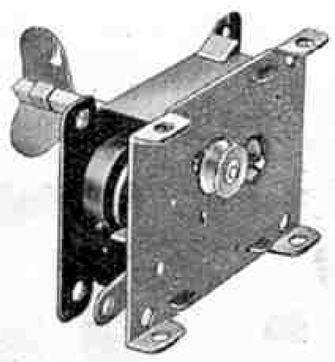
No. T6A Transformer (Output 40 VA at 9/3½ volts) for 6-volt Electric Motors and Locomotives. Fitted with speed regulator and separate circuit for supplying current for eighteen 3½-volt lamps ... ... Price 22/6

No. T20 Transformer (Output 20 VA at 20 volts) for 20-volt Electric Motors and Locomotives. Fitted with 5-stud speed regulator ... ... Price 17/6

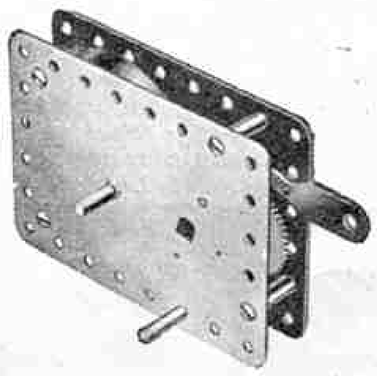
No. T20M Transformer (Output 20 VA at 20 volts) for 20-volt Electric Motors and Locomotives. This is similar to No. T20, but is not fitted with speed regulator ... ... Price 12/6

No. T20A Transformer (Output 35 VA at 20/3½ volts) for 20-volt Electric Motors and Locomotives. Fitted with speed regulator and output sockets for lighting lamps ... Price 22/6

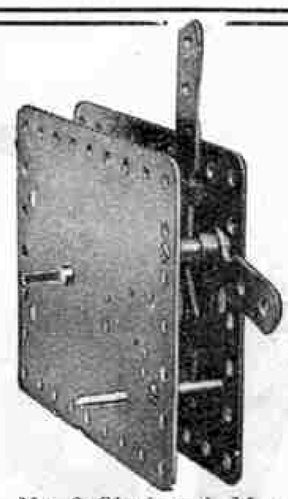
MECCANO LIMITED — BINNS ROAD — LIVERPOOL 13



X-series Clockwork Motor



No. 1 Clockwork Motor



No. 2 Clockwork Motor

Accumulator (6-volt, 20 amp. hr.)

REAL ENGINEERING IN MINIATURE

MECCANO IS

The Best Hobby in the World for Boys

Every boy is happiest when he is inventing, creating and building. That is the reason for the everlasting popularity of Meccano. It is the most wonderful and the most fascinating hobby in the world, because it enables full scope to be given to all the inclinations and desires that are the natural heritage of boys.

The Meccano System is better now than ever. All the parts are finished in a striking new colour combination of Blue and Gold, and the models constructed with them are of a brilliance never before attainable. In addition, the scope of the Outfits is greatly increased by the inclusion of new and specially designed parts. Among these are Strip Plates, intended primarily for filling in purposes; Hinged Flat Plates that simplify completely the problem of roof structures; Flexible Plates made of fibre board that can be bent to almost any desired shape; and a Road Wheel and Steering Wheel that will be invaluable to builders of Motor Car models.

See the New Meccano at your dealers. Take Dad with you!

Prices of Meccano Outfits

COMPLETE OUTFITS

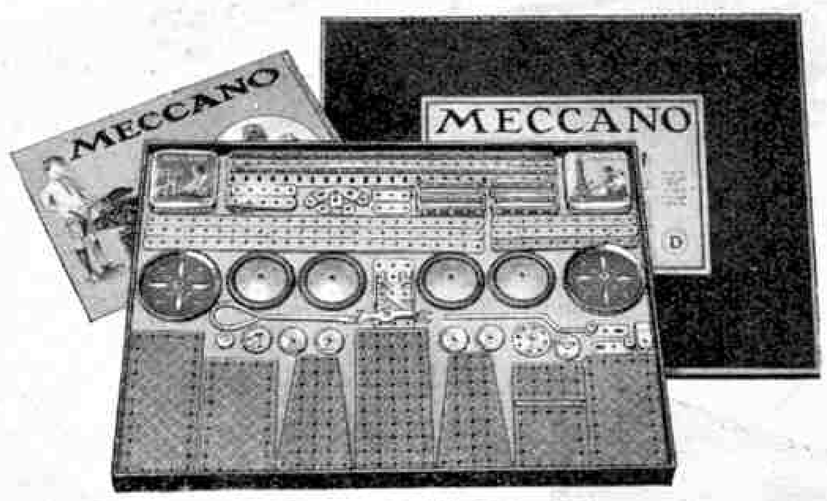
A	Outfit	each	5/–
B	,, ...	,,	7/6
C	,, ...	,,	10/–
D	,, ...	,,	15/–
E	,, ...	,,	20/–
F	,, ...	,,	30/–
G	,, ...	,,	55/–
H	,, (Carton)	,,	72/6
Hw	,, (Cabinet)	,,	97/6
K	,, (Carton)	,,	132/6
Kw	,, (Cabinet)	,,	157/6
L	,, (,,)	,,	410/–

ACCESSORY OUTFITS

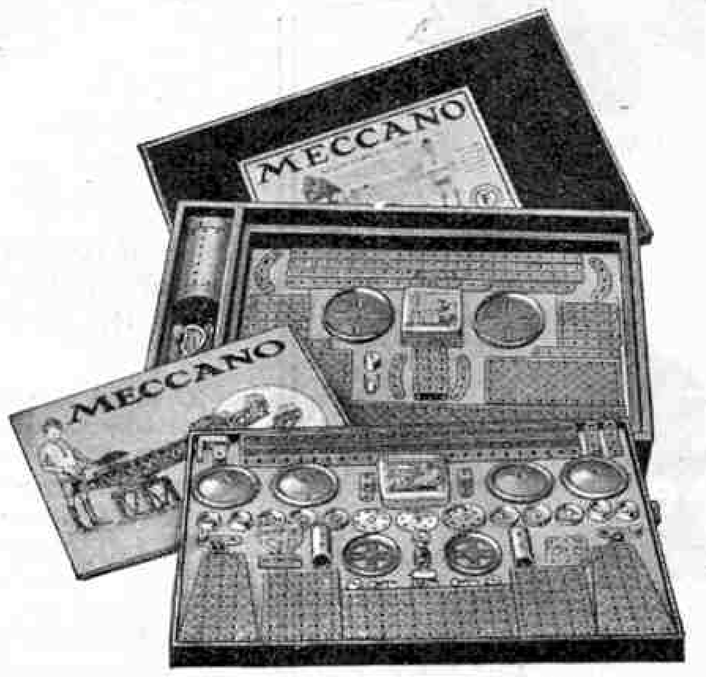
Aa	converts	A	Outfit into	B	each	2/6
Ba	,,	B	,, ,,	C	,,	3/–
Ca	,,	C	,, ,,	D	,,	5/6
Da	,,	D	,, ,,	E	,,	5/6
Ea	,,	E	,, ,,	F	,,	11/–
Fa	,,	F	,, ,,	G	,,	26/6
Ga	,,	G	,, ,,	H	,,	17/6
Ha	,,	H	,, ,,	K	,,	60/–
Ka	,,	K	,, ,,	L	,,	225/–

Meccano Limited, Binns Road, Liverpool 13

A Meccano Outfit. Price 5/–

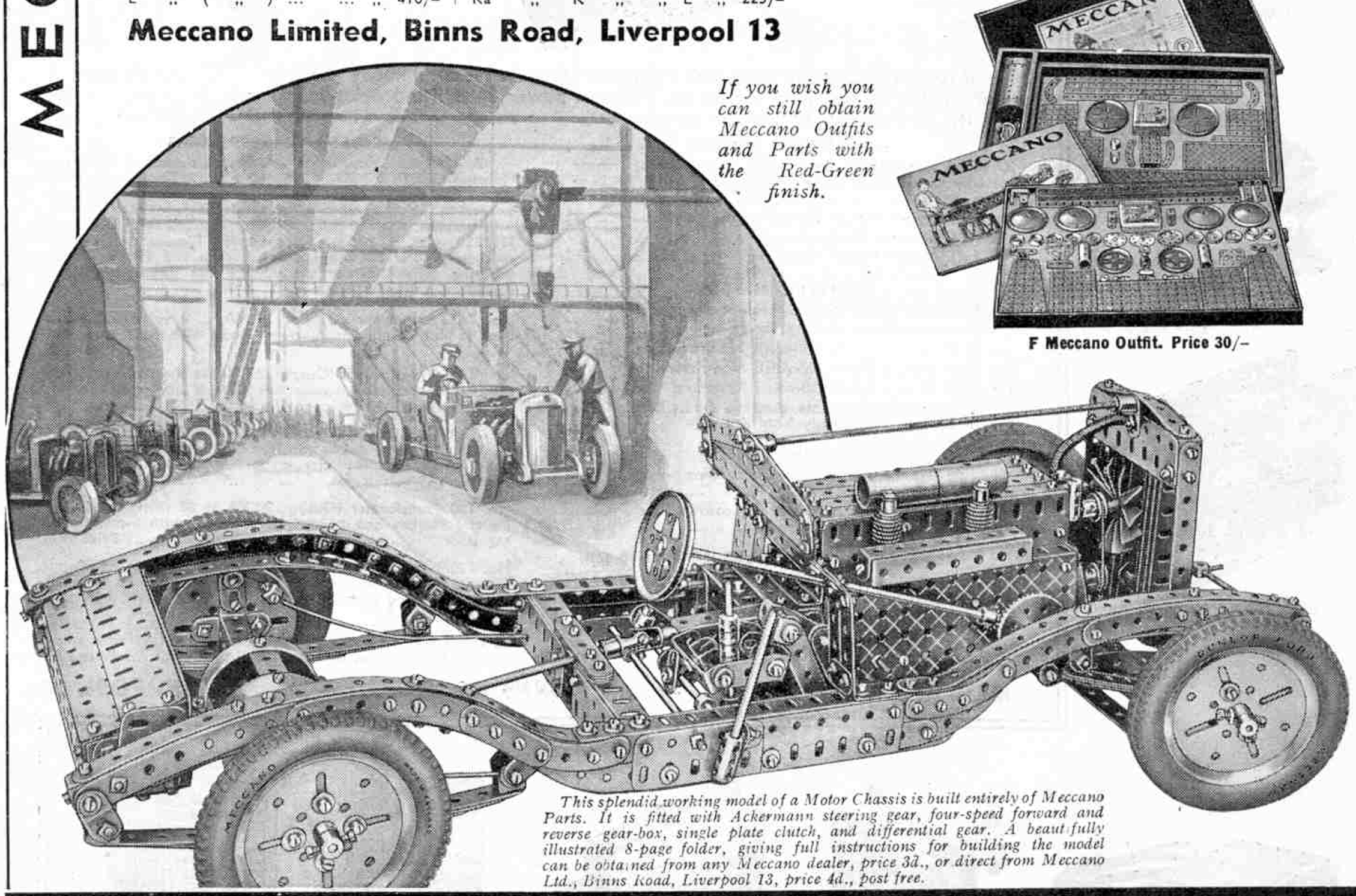


D Meccano Outfit. Price 15/–



F Meccano Outfit. Price 30/–

If you wish you can still obtain Meccano Outfits and Parts with the Red-Green finish.



This splendid working model of a Motor Chassis is built entirely of Meccano Parts. It is fitted with Ackermann steering gear, four-speed forward and reverse gear-box, single plate clutch, and differential gear. A beautifully illustrated 8-page folder, giving full instructions for building the model can be obtained from any Meccano dealer, price 3d., or direct from Meccano Ltd., Binns Road, Liverpool 13, price 4d., post free.

MECCANO

A Fascinating Pastime for Boys and Girls

The new Meccano Dinky Builder Outfits are ideal for all young boys and girls who are interested in model-building. The parts, tastefully enamelled in jade green and salmon pink, are fitted together in the most simple manner without the use of any nuts and bolts, giving results that are attractive and of exceptional interest. Two Outfits are available: No. 1 for general construction, including wheel toys, and No. 2 for making groups of miniature furniture. A brightly coloured Instruction Folder, that shows how extremely interesting and ingenious are the models that can be built, is included with each Outfit.

Your dealer will be pleased to show you these fine new Meccano Dinky Builder Outfits.

No. 1 Dinky Builder Outfit

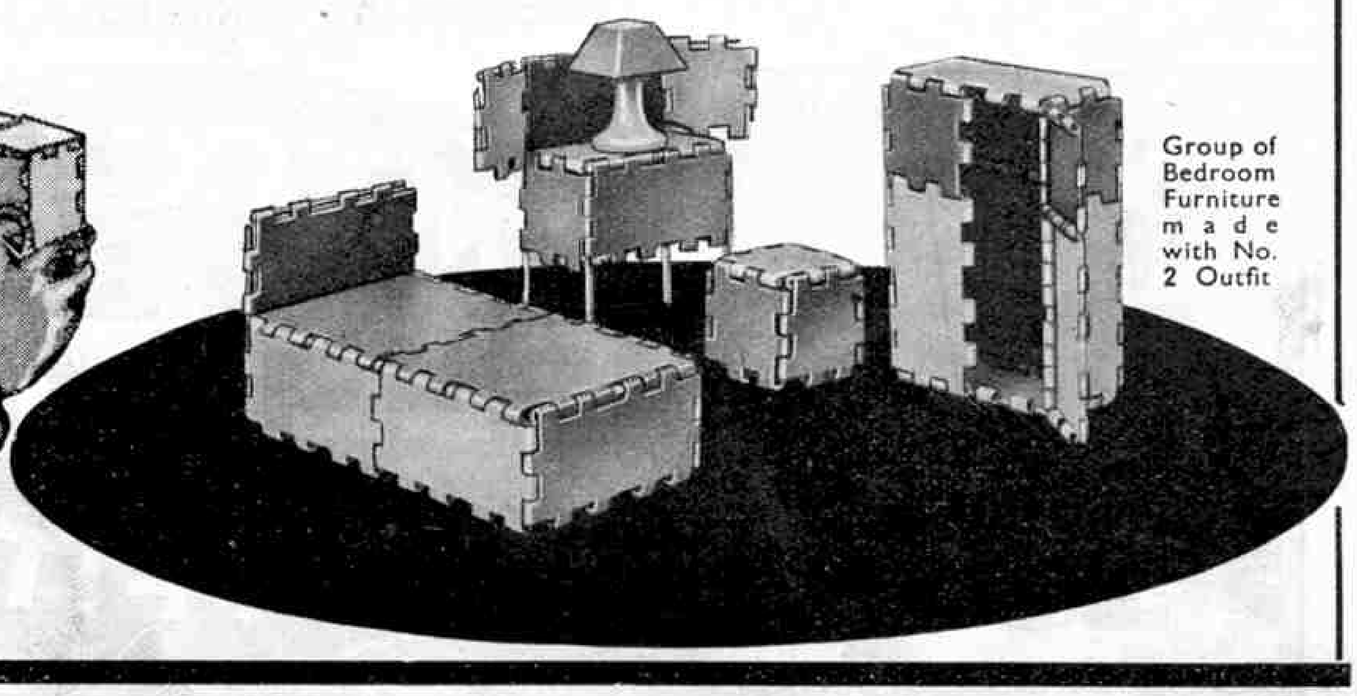
This Outfit contains a good selection of parts with which a large number of models can be made. It includes two trees on die-cast stands that lend the correct atmosphere to models of farm buildings, churches, etc. A further attraction are the wheels, finished in blue with white tyres, for constructing miniature wheel toys. The beautifully coloured instruction leaflet included in the Outfit illustrates a total of 44 models that any boy or girl can build. Price **5/-**

No. 2 Dinky Builder Outfit

The No. 2 Dinky Builder Outfit contains a wide selection of parts primarily intended for the construction of realistic groups of miniature modern furniture. The small table lamp and shade that are included add greatly to the realism of these groups, particularly as the lamp can be lighted from an ordinary flash lamp battery. The coloured instruction leaflet gives examples of 7 furniture groups, but to an enthusiastic model builder the possibilities of the Outfit are practically inexhaustible. Price **7/6**

MECCANO DINKY BUILDER

Manufactured by Meccano Limited, Binns Road, Liverpool 13



Group of Bedroom Furniture made with No. 2 Outfit

MECCANO ELEKTRON ELECTRICAL OUTFITS

No. 1 Elektron Outfit Price 6/6

In these days of radio, X-rays, and electric trams and trains, every boy should have a knowledge of electricity. The only way to gain this knowledge is by means of experiments, and the Meccano Elektron Outfits have been produced for this purpose.

These Outfits contain all the materials for carrying out a splendid series of fascinating experiments, commencing with Magnetism and passing on through Frictional Electricity to Current Electricity. In addition many interesting mechanisms can be constructed, including a Reading Lamp, an Electric Bell, a Telegraph, a Shocking Coil that gives real shocks, and Electric Motors.

No. 2 Elektron Outfit Price 21/-

Electricity is the most wonderful force of the age in which we live.

■

Learn some of its marvels by means of experiments with a Meccano Elektron Outfit.

No. 1 MECCANO ELEKTRON OUTFIT

Magnetism and Static Electricity

The No. 1 Outfit contains two powerful Bar Magnets and a reliable Magnetic Compass, together with everything necessary for the carrying out of a series of fascinating magnetic experiments. In addition there are materials for experiments in frictional or static electricity, and for the construction of an Electric Compass and two forms of Electroscope. Price **6/6**

No. 2 MECCANO ELEKTRON OUTFIT

Magnetism, Static and Current Electricity

The No. 2 Elektron Outfit contains all that is included in the No. 1 Elektron Outfit, with additional parts that enable a splendid series of experiments in current electricity to be performed. Among these parts are a Horseshoe Magnet, and Coils and Yokes for the construction of Electro-Magnets that can be used in building a real Electric Bell, and a Buzzer for use in an electric telegraph system. A specially-wound coil and other necessary parts are supplied for assembling into a splendid Shocking Coil that will give hours of fun and excitement. Price **21/-**

No. 1A MECCANO ELEKTRON ACCESSORY OUTFIT

An Accessory Outfit that converts a No. 1 Elektron Outfit into a No. 2 is also available. Price **14/6**

The apparatus and chemicals included in the Meccano Elektron Outfits can be obtained separately. Ask your dealer for the Elektron Folder giving a list of Elektron parts, or write for a copy to the address below.

MECCANO LTD., BINNS ROAD, LIVERPOOL 13

An Elektron Outfit will open up to you a fascinating hobby of endless variety.

■

Visit your dealer to-day and ask him to show you one of these wonderful Outfits.

NEXT MONTH: "SHIPPING GIANT LOCOMOTIVES TO CHINA." PUBLISHING DATE: 1st MARCH

MECCANO MAGAZINE

Editorial Office:
Binns Road, Liverpool 13
England

Vol. XX. No. 2
February, 1935

With the Editor

The Flat Earth Fallacy Again

I have no doubt that many of my readers remarked the death near Bath a short time ago of a man who had spent 50 years in trying to prove that the Earth is flat. When only 20 years of age, he took an oath to his father that he would do this, and for the rest of his life he studied the skies, spending his nights with instruments in his garden and never going to bed.

It is astonishing to find that this flat earth fallacy crops up in every generation. It was natural for our earliest ancestors to think that their home was flat, for they were unable to travel beyond a certain limited region, and could not picture the Earth as a whole. As soon as Man began to examine his home more closely, to travel farther afield, to watch eclipses and to study the Sun and the stars, the conviction grew that actually it is shaped like a ball. There are many proofs of this, most of which will be known to my readers. One of the most interesting, with which they are perhaps not so familiar, is a long-distance photograph recently taken in South America on a plate sensitive to infra-red rays. This shows part of the Pampas, the great grassy plain east of the Andes, and in it the distant horizon is distinctly seen to be curved, exactly as required by the belief that the Earth is roughly spherical in shape.

Perpetual Motion a Delusion

I am often surprised to realise how many illusions are still cherished, in spite of the wonderful advances that have been made in scientific knowledge. For instance, scarcely a month goes by in which a scheme for perpetual motion is not submitted to me by some enthusiast. The impossibility of achieving this has been proved many times, but belief in it still persists. The favourite idea is the unbalanced wheel, which is kept in motion by weights that change their position as it rotates. There must have been thousands of repetitions in some form or another of this device, but none of them has worked, for the simple reason that the weights have to be raised to the level from which they fall, and this absorbs all the energy produced.

In another form of this fallacy a dynamo and a motor are coupled together so that the dynamo produces the current required to drive the motor, and the motor in return drives the dynamo. Unfortunately this pleasing co-operation demands a perfect dynamo and a perfect motor, with no waste of energy from friction or the production of heat. These of course are impossible, but even if the scheme were feasible, there would be no surplus energy that could be applied to practical purposes.

All other schemes also have failed, and it is safe to say that no perpetual motion machine ever will work.

Airways in 1935

In view of the extraordinary developments of aviation at the present day, it is difficult to realise that it is little more than 30 years since the Wright Brothers succeeded in making the first flight in a heavier-than-air machine. There is no doubt that the world as a whole is becoming more air-minded. Fears and prejudices are passing away, and the idea of travelling by air is becoming generally accepted. It is rash to prophesy, but I cannot help thinking that 1935 may well mark the beginning of a great forward movement which, in the end, will result in the air becoming a great highway ranking equally in importance with roads and the sea.

It is the outstanding events of last year that have caused me to look ahead in order to see what the prospects are for aviation in 1935. The wonderful flight to Australia of Scott and Black in their D.H. "Comet," and the equally remarkable return flights to Australia and the Congo Free State of a second machine of this type, have shown how reliable high speed aeroplanes are. The speeding-up of the Imperial Airways services, now extended to Australia, is another indication of the progress that is being made, and soon it will be possible to fly in comfort half way round the world in little more than a week.

I scarcely expect that a trans-Atlantic aeroplane passenger service will be established this year, but it may become possible to cross the North Atlantic Ocean in an airship. Regular flights by German airships to South America were made last year and are to be repeated this year, and in preparation for extensions a new airship base is to be established at Frankfurt.

Blazing coals from a furnace held without discomfort by the wearer of a Bestobell "Bellmunn" asbestos glove. Photograph by courtesy of Bell's Asbestos and Engineering Supplies Ltd.

Asbestos Gloves for Readers

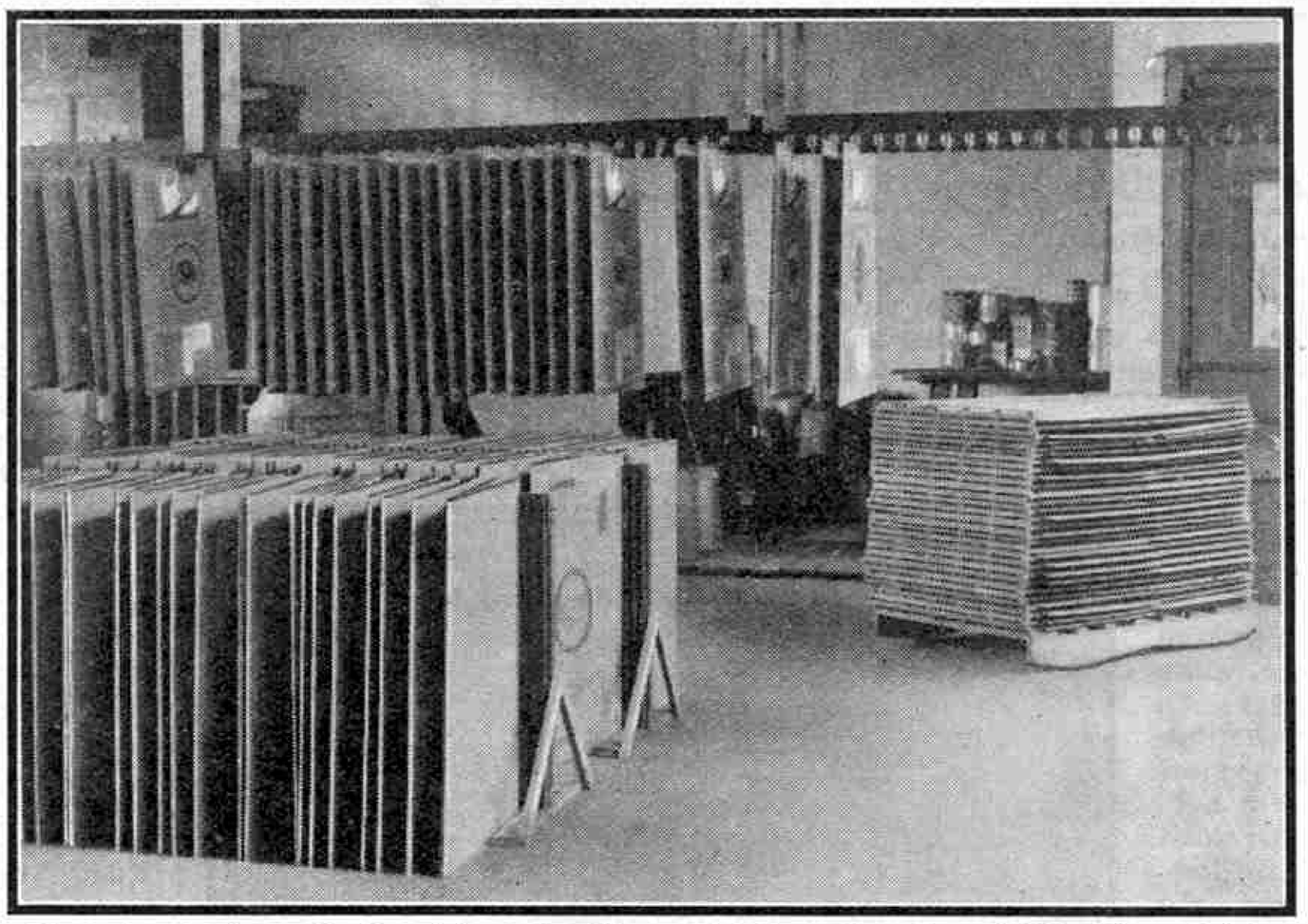
The interesting illustration on this page gives a convincing proof of the wonderful heat-resisting powers of asbestos. This mineral cannot take fire and is a very poor conductor of heat, and many startling feats similar to that shown in the photograph can be performed with the aid of the protection it gives. It is invaluable in fire prevention, for an adequate lining of asbestos makes a room or building practically fireproof, and screens or clothing made of asbestos are helpful to fire fighters.

Other uses for asbestos are suggested in the *"Of General Interest"* pages of this issue. No doubt many of my readers have interesting ideas on this subject, and by the kindness of Bell's Asbestos and Engineering Supplies Ltd. I am able to offer 12 prizes, each consisting of a pair of asbestos gloves, for the 12 most original practical suggestions for uses for asbestos in any form. Suggestions from home readers should be forwarded to reach me not later than 28th February, and the closing date for those overseas is 31st May.

Silk Screen Colour Printing

An Ancient Egyptian Process Modernised

IN this article we describe an interesting system of printing in colours that is finding increasing use in the production of showcards, posters, and similar work in which a bright colourful design is required. The system is known as silk screen printing, and we are indebted for our information to the courtesy of British Silk Screen Printers (1933) Ltd., Liverpool. The silk screen method of printing is not really a new idea, for a somewhat similar process was used thousands of years ago by the ancient Egyptians and Chinese, who employed it in certain kinds of reproduction work. Later the monks in this country obtained some of the beautiful effects that we find in their manuscripts by a method that is closely allied to the modern silk screen process.



After each colour impression the prints are placed in special drying racks as shown in this photograph, taken at the works of British Silk Screen Printers (1933) Ltd., to whom we are indebted for our illustrations.

The fundamental difference between silk screen printing and the more usual multiple colour printing systems is that no printing blocks are used, and the finished work can be produced in any number of pure colours. The work done by the silk screen process is very fine, and the unlimited variety of beautiful colour schemes that can be introduced are exceptionally pleasing. An additional advantage is that the process can be used on almost any kind of material, including paper, glass, rubber, canvas and metal, and as the finished work is waterproof, a print can be washed when it becomes dirty, and its beauty restored.

This illustration shows a silk screen operator squeegeeing a print. By a steady sweeping movement of the rubber squeegee the operator presses the paint through the silk screen, which is held taut in the oblong frame on the printing bench.

Silk screen printing has been in use in England for some years, but it is only recently that it has been adopted to any great degree. Modern silk screen operators have improved the process considerably, and it is now used to a considerable extent for the making of very fine high-class coloured reproductions.

Essentially the silk screen process consists of applying paint to paper, or some other printing surface, through a taut sheet of silk, or a silk screen as it is named, the paint being pressed through the silk by a heavy flat rubber squeegee. The actual operation of squeegeeing may be done either by hand or on specially made machines. Cellulose paint is used for printing on glass or metal, and lead free oil paint for printing on paper and cardboard.

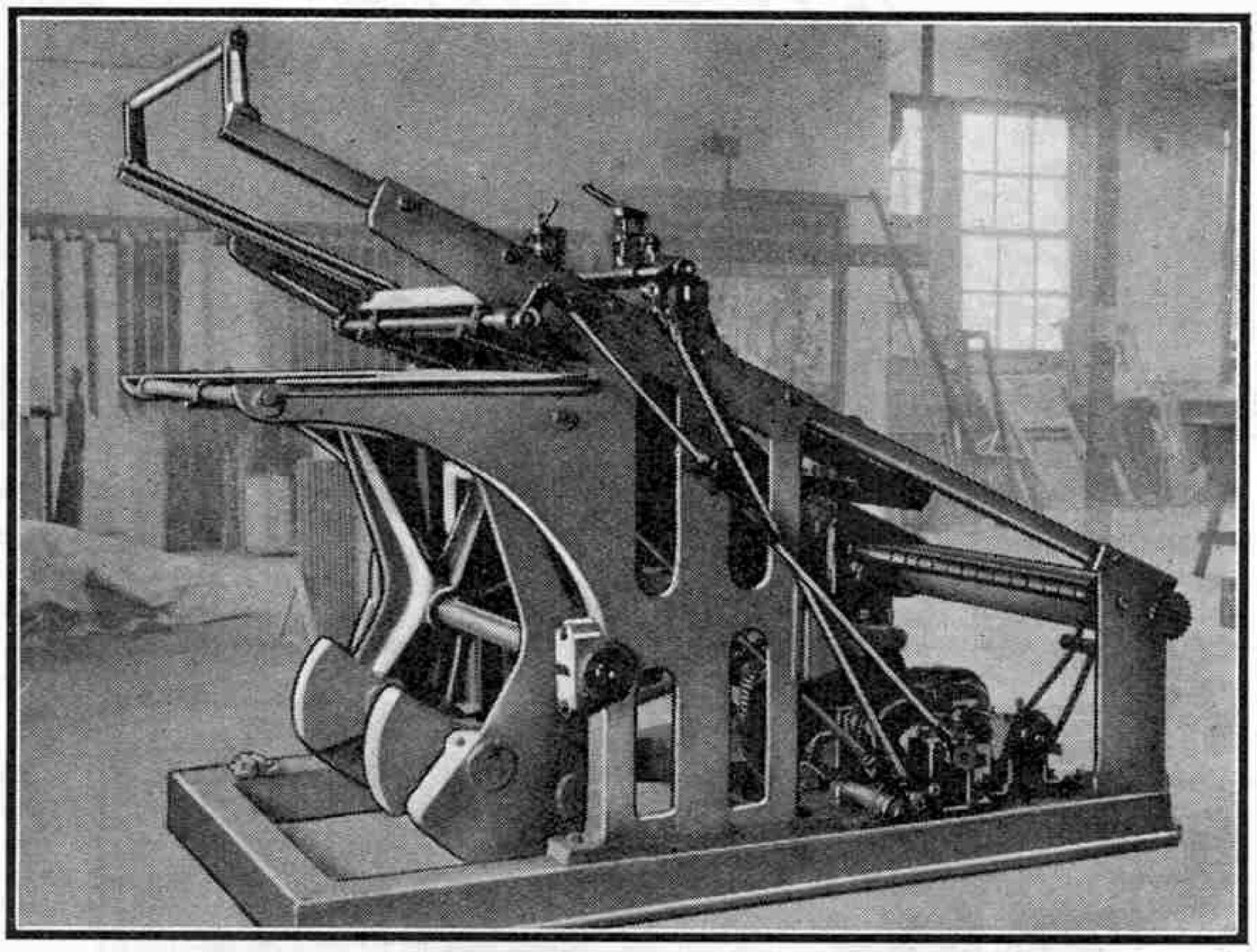
The silk used for the screens is specially made for the purpose, and although it is expensive, the price averaging about 25/– per yard, its life is very extensive, and if carefully handled a screen will give from 50,000 to 60,000 impressions. For cheap work muslin is sometimes substituted for silk, but the resulting prints are very rough in comparison with those produced through silk.

In order to produce a definite design in the finished print, it is necessary to arrange matters so that the paint can pass through the silk screen only in the required places. There are various methods of effecting this. Sometimes a stencil, made either of paper or of a special material known as pro-film, is cut by an artist, and attached to the underside of the silk. Another method consists of applying to the silk itself a filling paste composed of cellulose or other suitable material. The "filler" stops the mesh of the silk except in those parts where it is desired to let the colour through to form the design.

For certain classes of work the stencils are made by a photographic process. In this the silk is coated with

gelatine rendered sensitive to light by a solution of potassium bichromate. The required design for the stencil is drawn by an artist either on transparent paper or on a sheet of glass, the portions of the design that are to be "stopped," so as to form a barrier to the light, being painted either with black ink or some other opaque substance.

The design thus produced is known as a "positive," and it is placed in contact with the silk screen in a frame of very similar type to an ordinary photographic printing frame, and then exposed to daylight. The parts of the sensitive gelatine that are protected from the light by the opaque paint on the positive remain unaffected, but the parts that the light reaches undergo a chemical change that renders the gelatine insoluble in water. After exposure the silk with its gelatine coating is placed in a dish of hot water. The result is that the parts of the gelatine that were protected from the light dissolve and are washed away, leaving on the silk a perfect stencil of the design.



A view of a Selectasine power press for silk screen printing. The machine has a maximum printing surface of 32 in. × 45 in. The silk screen slides beneath a stationary squeegee assembly in order to take the impressions.

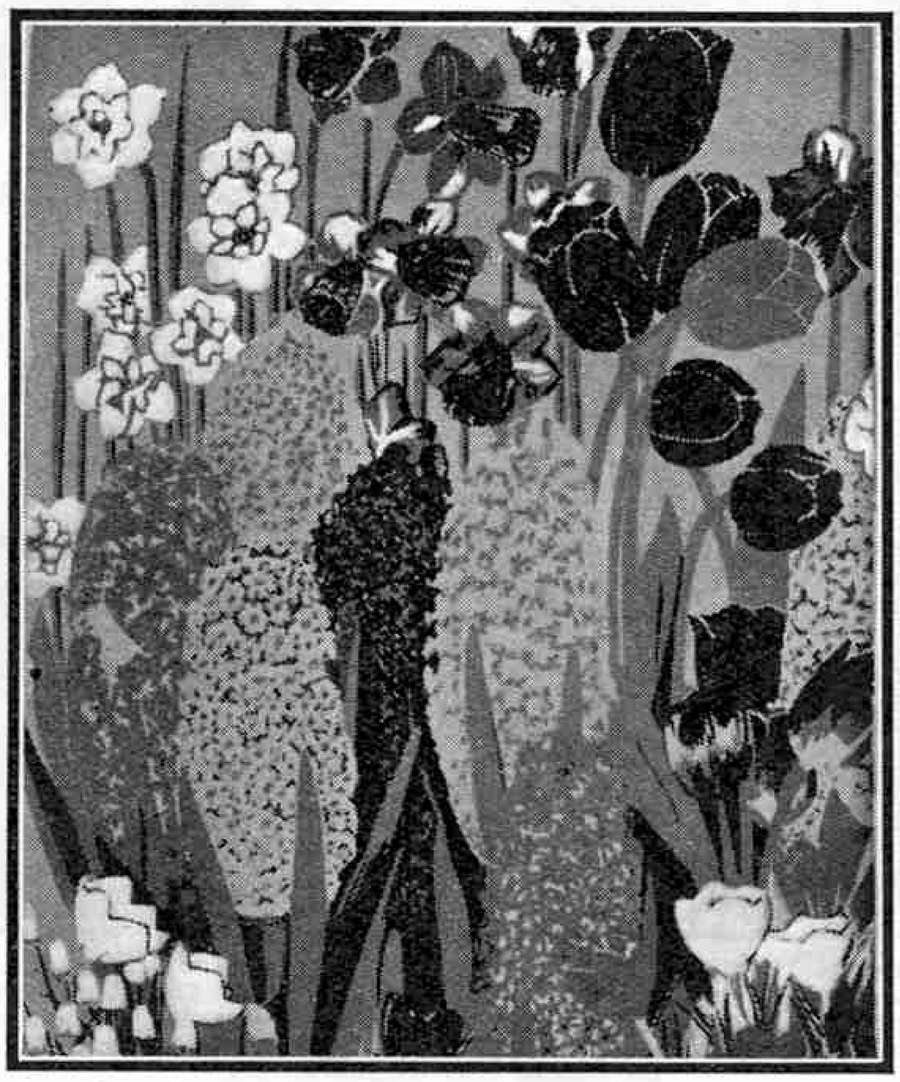
After drying, the silk is printed through with a flat squeegee in the manner already described when using a paper stencil.

So far we have dealt with designs printed in one colour only. In printing, say, a showcard in several colours, the method of operation is the same as that when printing in one colour, but a separate prepared silk screen is required for each colour in the artist's original design.

To produce a showcard in three different colours such as yellow, red and blue, the first step is the making of a full size design in colours. This is done by a skilled artist, and everything he paints in his small original will be reproduced exactly in the finished showcard. If the printing is to be done through an ordinary cut-out stencil, the artist's original is passed to a stencil artist who then cuts a separate stencil, either in paper or pro-film, for each different colour in the original design. This means that one stencil will be made including all the yellow portions of the design, a second stencil of all the red parts, and a third of all the blue portions. Every part of the original full size sketch prepared by the artist is therefore included in one or other of the three stencils.

The stencil cutter's work is very highly skilled, and plays a big part in ensuring the fine quality and beauty of the print. As a separate stencil is needed for each separate colour required in the print, as many as 12 or more stencils are used in producing an elaborate design. Once the stencils have been made, however, a great number of prints can be produced, so that the comparatively high original cost is negligible provided that a reasonable quantity of prints are required.

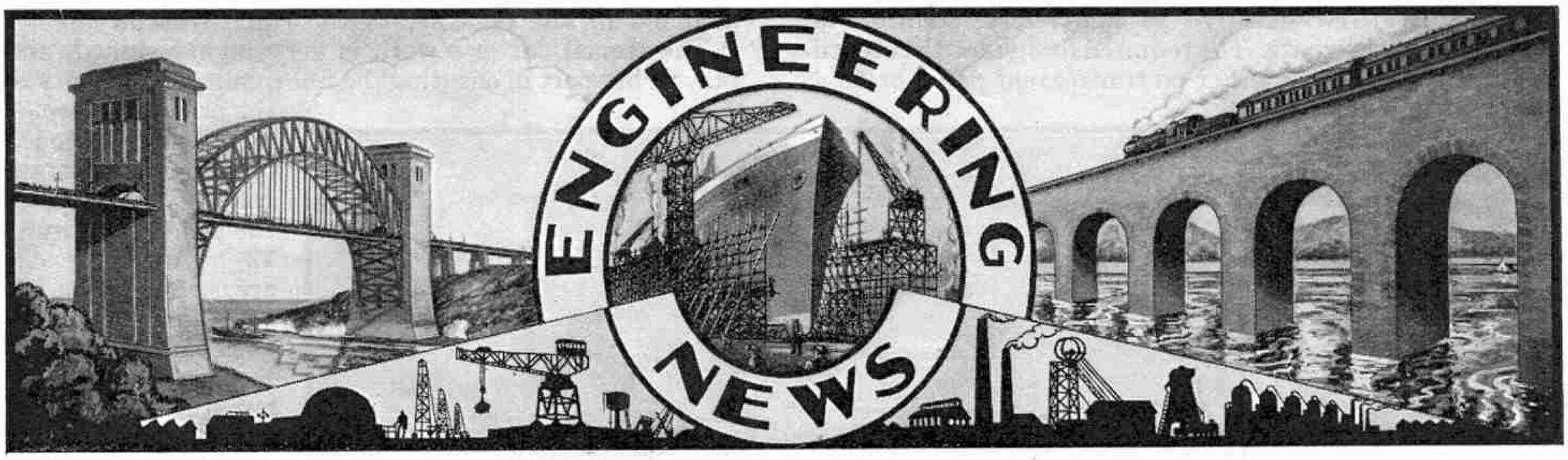
To print a three-colour design three silk screens will be required, each screen being simply a piece of special Swiss silk of extremely fine mesh. The silk is somewhat larger than the size of the showcard to be printed, and it is held taut on a special stretcher frame, which is pivoted on a peculiar type of hinge at one end to the work table of the printing bench. Each of the three screens is fitted with one of the prepared stencils, which is attached to the silk on the underside so that the stencil will be next to the paper when the print is made. Paper stencils are attached to the silk by cellulose, but stencils made from pro-film contain a shellac adhesive and are attached simply by pressing them to the silk with a hot iron.



A portion of a poster advertising bulbs, which was produced by the silk screen process. The actual poster is printed in seven brilliant colours against a grey background.

When the stencils are affixed to the screens, the sheet of paper or card to be printed is carefully adjusted in position beneath the first screen, which we will suppose to be that bearing the stencil of the yellow portions of the design. After the stencil is fixed, the surrounding portions are filled in with green filler. The screen is then lowered on to the paper, and the paint is forced through the silk by drawing the flat rubber squeegee across. The paint can penetrate only at those parts where the stencil is perforated, or the silk is not stopped by filler paste. The screen is then raised, and the paper, which now bears a reproduction of the yellow parts of the design, is transferred to special drying racks. When the first impression is quite dry the paper is placed under the second screen, to which the stencil of the red parts of the design is fixed, and so on to the third screen. When the three colours have been applied an exact replica of the original

(Continued on page 94)

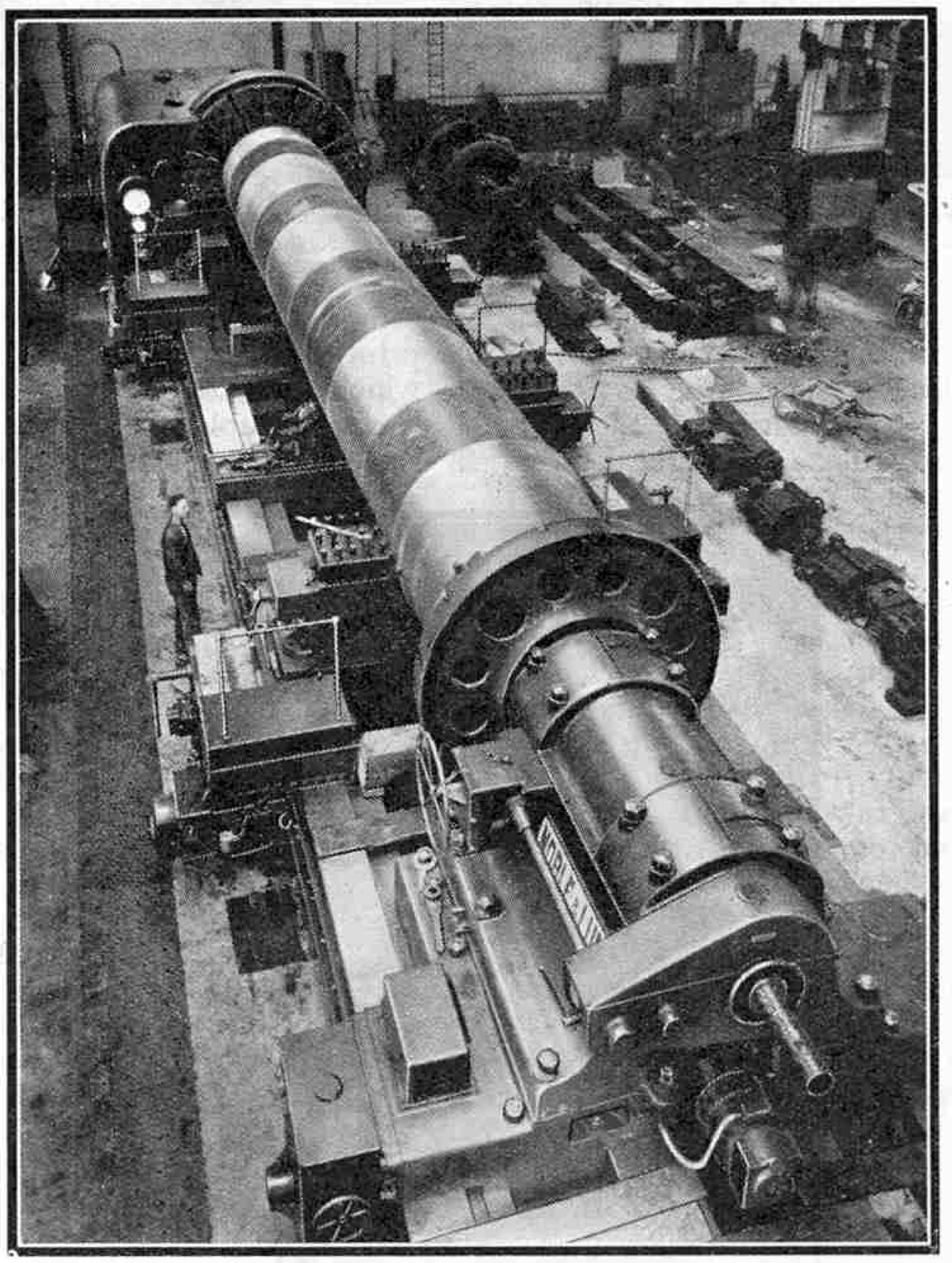


Grinding and Polishing of Plate Glass

There are many interesting features about the manufacture of glass, one of which is that although the craft is perhaps as old as civilisation itself, it has seen remarkably few changes in essential methods. Ordinary glass consists principally of quartz sand that is heated to a high temperature in a furnace until it has melted, and is then drawn into sheets, cast into slabs, or blown and pressed into various forms. Plate glass is rather more difficult to make. One largely used method of manufacture consists of taking the molten glass from the furnace, pouring it on to an iron or steel casting table, and passing a metal roll over it while it is still molten in order to make a slab of glass of uniform thickness. The slab is then placed in an annealing oven where it is left to cool gradually to room temperature, so as to prevent the development of strains or brittleness that would render it unfit for its special commercial uses.

The slab of glass thus formed is then ready to be ground and polished. For this purpose it is placed on a circular revolving table and its surface is ground to smoothness by abrasives pressed to it by means of hard wood-covered discs. Further polishing is carried out by means of a polishing rouge held to the surface of the glass by flat pads to which sufficient weight is applied to produce the required result. When both sides have been treated in this manner, and the necessary polish and transparency produced, the glass is washed and cut as required.

The lower illustration on the next page shows a large grinding and polishing machine. This consists mainly of a large circular cast iron table 25 ft. in diameter and weighing approximately 37 tons. It is mounted on a cast iron spider 11 ft. in diameter and weighing some 4½ tons, fixed to the upper end of a vertical cast steel shaft 14 ft. in diameter supported by special bearings. The superstructure over the table, carrying the large wood-covered discs for grinding and the weighted felt pads for polishing, consists principally of 15-in. structural I-beams supported at each end by cast iron stands. The wood-covered discs and felt pads, which weigh several thousand pounds, are raised and lowered by means of hydraulic lifts that are suitably located for the purpose. The machine in working order weighs about 89 tons.



This photograph shows one of the most powerful lathes ever constructed in this country, which was described on page 609 of our issue for August last. The lathe is owned by the English Steel Corporation, and is in use at their Vickers Works, Sheffield, and not at their Openshaw Works, as previously stated. Our photograph is reproduced by courtesy of the English Steel Corporation Ltd.

Swiss Electric Cable Railway

A cable railway that has been opened in Switzerland between Schwyz and Stoos is 1,489 yds. in length and is operated by electricity. It is provided with carriages that hold 50 passengers and are driven at a speed of about 4½ m.p.h. The cable that hauls the carriages is 35½ mm. in diameter.

A Ship with Boilers on Deck

Among recent schemes for increasing the efficiency of vessels devoted mainly to the carriage of cargo is one in which the boilers are situated on the main deck. Two vessels have been equipped in this manner, and one of them, the Norwegian ship "*Bencas*," visited this country not long ago. It is claimed that by placing the boilers on the deck more accommodation can be provided for cargo and passengers, and also that a saving in building costs can be effected. A further advantage claimed is simplification of the operations of coaling and discharging ash.

In the "*Bencas*," which is a vessel of 2,500 tons, the boilers are supported on special girders and are situated over the forward end of the engine room. The coal bunkers are accommodated between the decks near by, except one that is arranged over the boilers. A saving of labour is made possible in that it is not necessary for the coal to be trimmed periodically, as this is done automatically by gravity. Conditions are better for the stokers because, owing to the better ventilation that can be provided, the boiler house does not become so hot; while at the same time there is good natural lighting. The "*Bencas*" has a cruising speed of about 12½ knots.

Extensive Port Improvement Scheme

The L.M.S. Railway announce that important schemes, at a cost of over £85,000, are to be put in hand immediately for the further improvement and modernisation of the West Coast fishing port of Fleetwood. The two main features of the scheme are the provision of six electrical belt conveyors for coaling trawlers, and the conversion of the whole of the existing hydraulic plant at the port to electric power. In addition, siding accommodation will be constructed to take an extra 621 railway wagons. The scheme involves also practically the complete reconstruction of the wooden piers at the north end of the dock where the very extensive Isle of Man traffic is dealt with.

Diesel Engines for Lifeboat Use

The interesting announcement is made that the Royal National Life Boat Institution have decided to install two high speed heavy oil engines in a lifeboat that is shortly to be built. The Institution already possess 124 motor lifeboats, but all of these are fitted with petrol engines which, until recently, have been superior to heavy oil engines in regard to speed and lightness. Much progress has been made in the design of small Diesel engines, however, and now engines of this type are available that are suitable for small craft of all kinds. The Life Boat Institution's decision has been arrived at as the result of a series of experiments carried out with a 6-cylinder Diesel-type engine developing 85 b.h.p. at 1,600 r.p.m. and weighing 26½ cwt. This engine was installed in a reserve lifeboat, and has been used at various places while the regular boats were being overhauled. It is now permanently stationed at Yarmouth in the Isle of Wight.

170-Mile American Aqueduct

A big aqueduct that supplies San Francisco with water collected from an area in the Sierra Nevada 170 miles away, was completed and opened at the end of last year. The water is obtained at an altitude of about 4,660 ft. above sea level and is stored in the Hetch-Hetchy and Lake Eleanor reservoirs, the drainage area being about 713 sq. miles over which an average of 40 in. of rain falls every year. The scheme, which was started in 1910, provides San Francisco with 400,000,000 gallons of water every day, the feed to the city being by gravity owing to the height of the reservoirs.

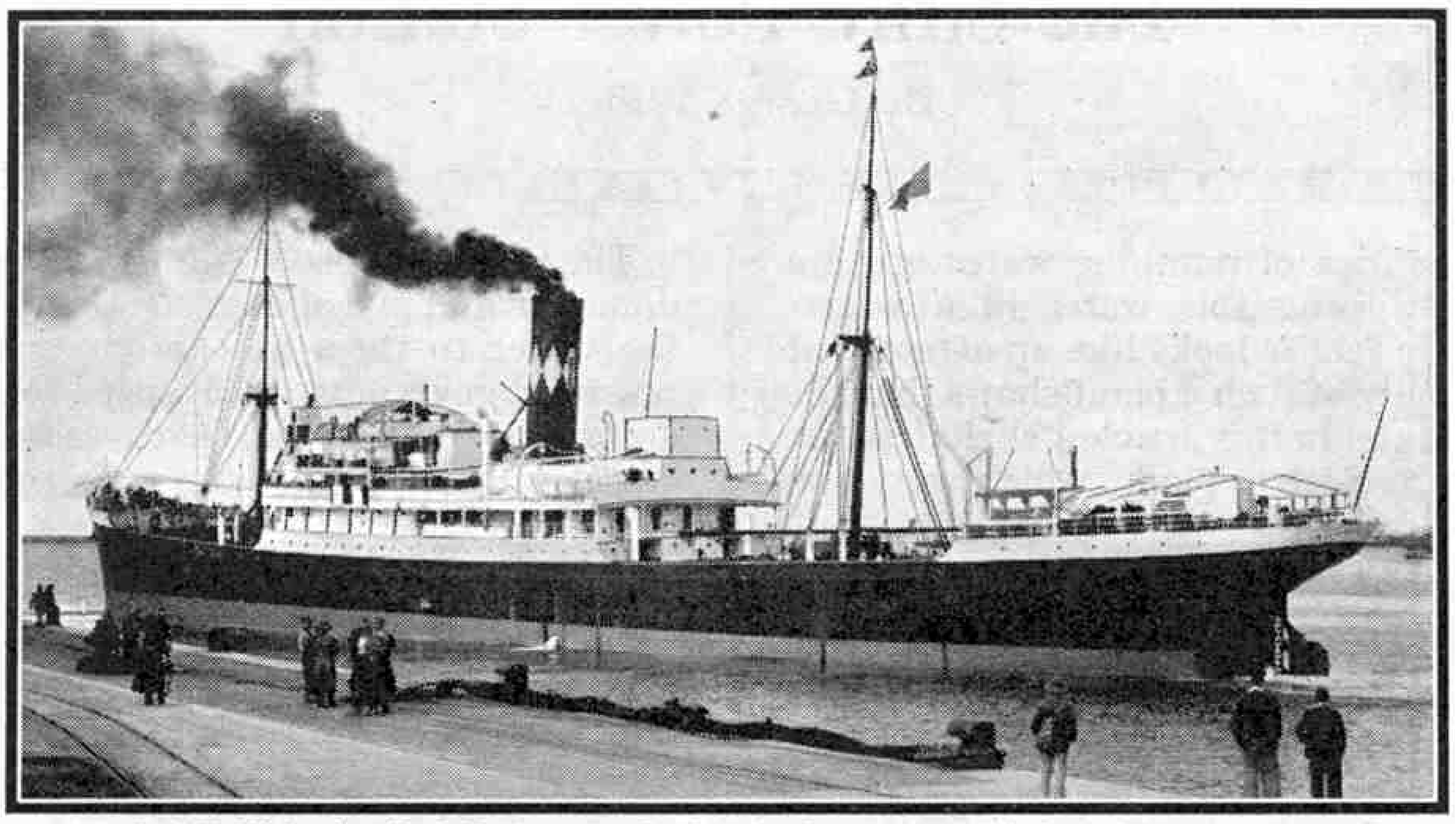
250-Ton Hammerhead Crane

The hammerhead crane that has been installed at the Puget Sound Yard of the United States Navy Department has a tower 125 ft. high and is capable of dealing with loads up to 250 tons. The revolving beam is 317 ft. long, the cantilever arm is 196 ft. 6 in. long from the centre of rotation and the counterbalancing arm is 120 ft. 6 in. long. The crane is equipped with two main hoisting trolleys that travel along the beam, each having a capacity of 125 tons and a working radius of 125 ft. There are also three other trolleys, one capable of lifting 30 tons and the others of raising 5 tons each at a high speed. These trolleys all have a working radius of 184 ft.

An interesting feature is a 25-ton travelling crane provided in a two-storey machinery house, situated on the counterbalancing arm and used to handle the machinery. All the movements of the hammerhead crane are carried out by electric power.

A New Thames Oil-Electric Tug

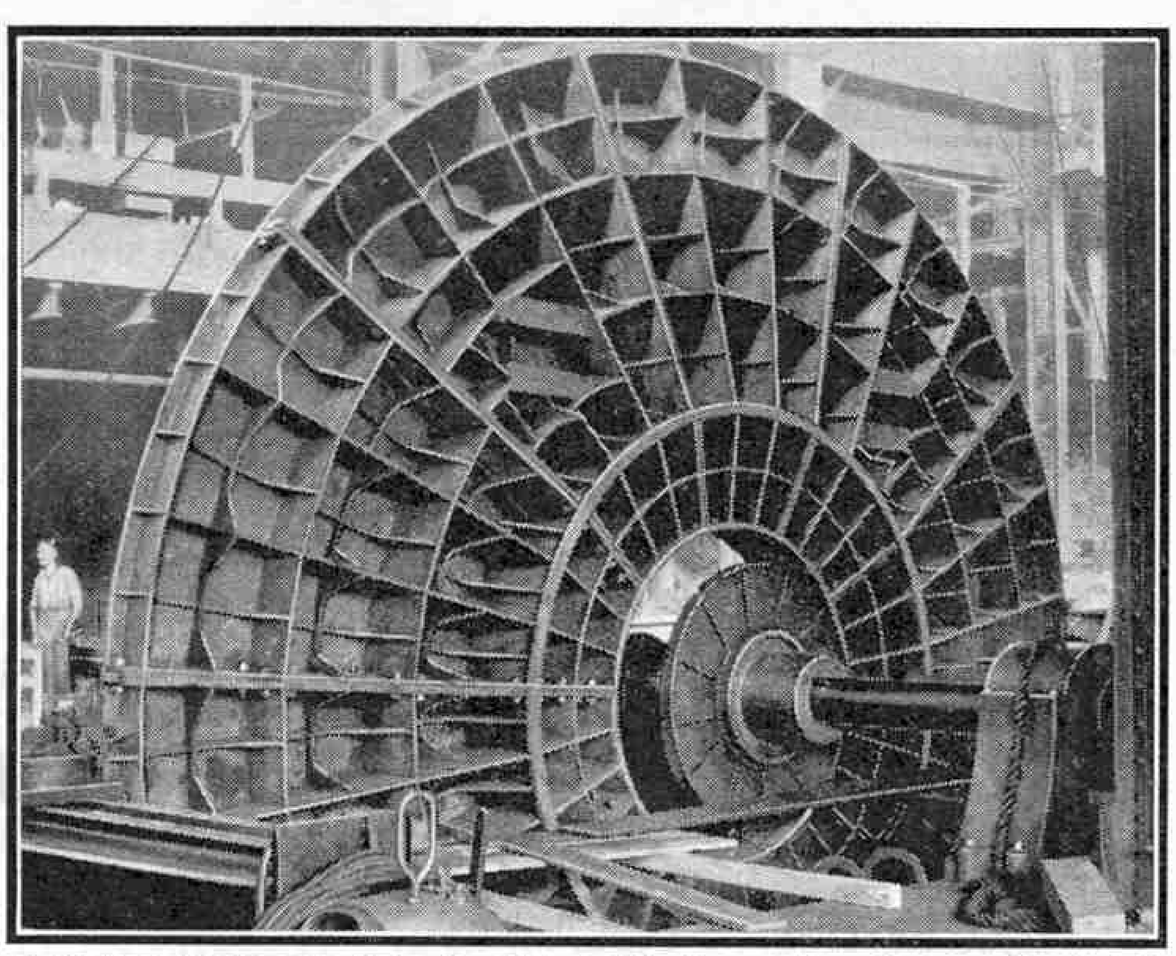
An oil-electric tug of modern design has recently been put into service on the Thames, where it is used for handling barges. The new tug is 77.5 ft. long and 19.5 ft. broad, and is fitted with a propelling motor that develops 400 b.h.p. at 100 r.p.m. Current for the motor is provided by two four-cycle single-acting airless injection engines each of which is coupled to a generator with an output of 165 kW at 530 r.p.h. The engines are controlled from the bridge.



The "Trafford Hall" leaving No. 1 Berth at the Charl Malan Quay at Port Elizabeth. Photograph by Mr. F. W. Wilson, Port Elizabeth.

Bearings that Carry Load of 400 Tons

It is interesting to learn that the bearings of the bridge that recently has been built at Barendrecht in Holland, and a Meccano reproduction of which is described on page 113 of this issue, are of British manufacture. There are 432 bearings on the bridge, the lift span of which is 400 tons in weight, and they were made by Ransome and Marles Bearing Co. Ltd. Some idea of the size of the main bearings can be gained from the fact that each has a bore of nearly 12 in. and is capable of carrying a load of about 70 tons. The sheaves supported by these bearings rotate at 6 r.p.m.



A machine used for grinding and polishing plate glass windows. The operation is fully described on the previous page.

Timber Compared with Concrete for Bridges

In the United States and Canada there are very many timber bridges, and when these reach the end of their useful career they are almost invariably replaced by structures of concrete or steel. An interesting exception has occurred recently at York Village, Maine, where a timber bridge built in 1761 has been replaced by another timber structure of almost exactly similar design. The new bridge, which is 22 ft. wide, is nearly 550 ft. long, made up of one span of 30 ft. and 13 spans of 17 ft. The main reason for deciding upon timber for the new bridge was that whereas a concrete structure would have cost nearly £5,500, the wooden bridge cost only £3,200. This saving is sufficient to meet the cost of maintaining the bridge in repair and to leave over enough to build a new bridge in about 50 years, by which time it is probable that a concrete bridge built now would be inadequate to deal with the traffic.

Opening of the Iraq Pipeline

Last month the ceremonial opening took place of the 1,150-mile pipeline that the Iraq Petroleum Company have constructed between their oilfields at Kirkuk and the two terminals of Tripoli in Syria and Haifa in Palestine. The ceremonies were five in number and took place successively in the five countries—Iraq, Syria, Lebanon, Palestine and Transjordan—through which the pipeline runs. We hope to publish a fully illustrated article on this interesting pipeline in an early issue of the *"M.M."*

A Yugoslavian Suspension Bridge

After 4½ years' work, an important suspension bridge with a span of 804 ft. has been built across the River Save between Belgrade, the capital of Yugoslavia, and Zemun. The bridge is 1,967 ft. in length, including its approach viaducts, and has cost about £850,000. In connection with its construction an extensive scheme of street clearance and reconstruction has been proceeded with, and on one side of the river a modern highway carried on an embankment has been built for more than two miles over marshy ground.

Photo-Electric Cell for Lift Bridge

An interesting method of informing the operator when the 300 ft. span of a bridge is exactly lined up has been developed in the United States. It consists of placing a photo-electric cell on the end of the span so that when it is exactly in position a beam played on it from one of the piers makes a green light show in the control room.

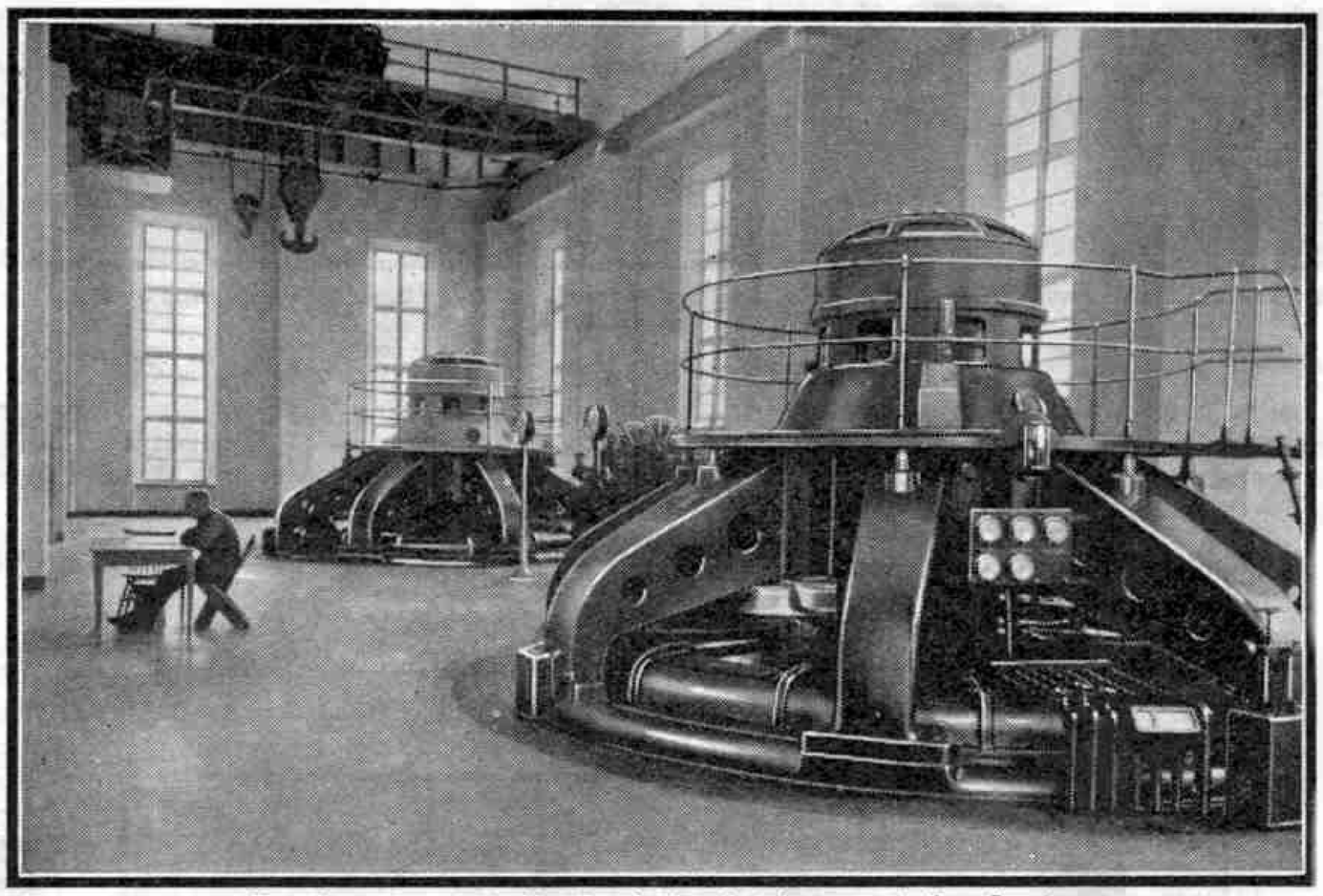
A Swedish Pumping and Hydro-Electric Plant

The Sillre Power Station

By George Willock

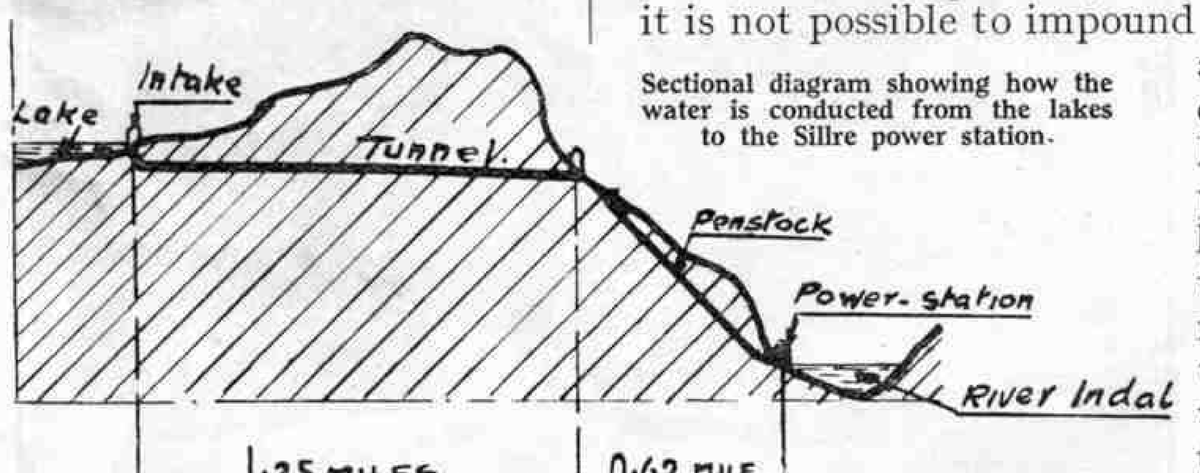
ON first thought the idea of pumping water up to a height and then utilising this water in a water-turbine seems absurd; in fact it looks like an attempt at perpetual motion. A study of such a plant shows that the idea is sound, however, and in this article I shall describe the Swedish Sillre hydro-electric plant, which works on this principle. In addition to being the first water pump-storage plant in Sweden, it operates on the highest head developed in that country.

The Sillre plant is situated on the Indal River, some 38 miles from the outlet of the river to the Gulf of Bothnia, and is owned and operated by the Royal Board of Water Falls. It is one of several that are known collectively as the Norrfors Power Supply Group, the name being based on that of a fine hydro-electric installation at Norrfors, on the Umea River, about 160 miles north of Sillre. At Norrfors the fall of the river consists of a series of rapids, and a portion of these is shown in one of the illustrations to this article. As the operation of this plant has a bearing on that at Sillre I will outline briefly its chief features.



The alternators at the Norrfors hydro-electric power station, Sweden.

The regulation dam is built across the Umea River at the top of the rapids, and is 750 ft. long and about 20 ft. high. It determines the head water level and acts as an overflow weir. During the lumber season great quantities of timber are floated down the river to sawmills, and to facilitate the passage of the logs about 150 ft. of the dam is built about 5 ft. lower than the remainder. The intake dam near the power house is built across the Tvär River, which joins the Umea River at Norrfors. It is a multiple arch structure of four spans each 40 ft. wide. The penstock inlet adjoins the intake dam, and from there the water is carried through two steel penstocks each 12 ft. in diameter and embedded in concrete, to two 13,000 h.p. vertical turbo-alternator sets. At present the turbines are operating on a head of 90 ft., but eventually this will be increased to 140 ft. and the output of each turbine will then be 25,000 h.p.



Sectional diagram showing how the water is conducted from the lakes to the Sillre power station.

The water wheels or runners of the turbines are 8 ft. in diameter and are of cast steel, and the gates that admit the water to them are automatically controlled by oil pressure governors. The speed of the turbines varies according to the load. A decrease in speed causes the governor head to open the main regulating valve, admitting pressure oil to the opening side of the servo-motor regulating the gates, which then open and allow a greater quantity of water to pass until the turbine has regained its normal speed. If the speed rises above normal the servo-motor closes the gates, thereby decreasing the supply of water and reducing the turbine speed to normal.

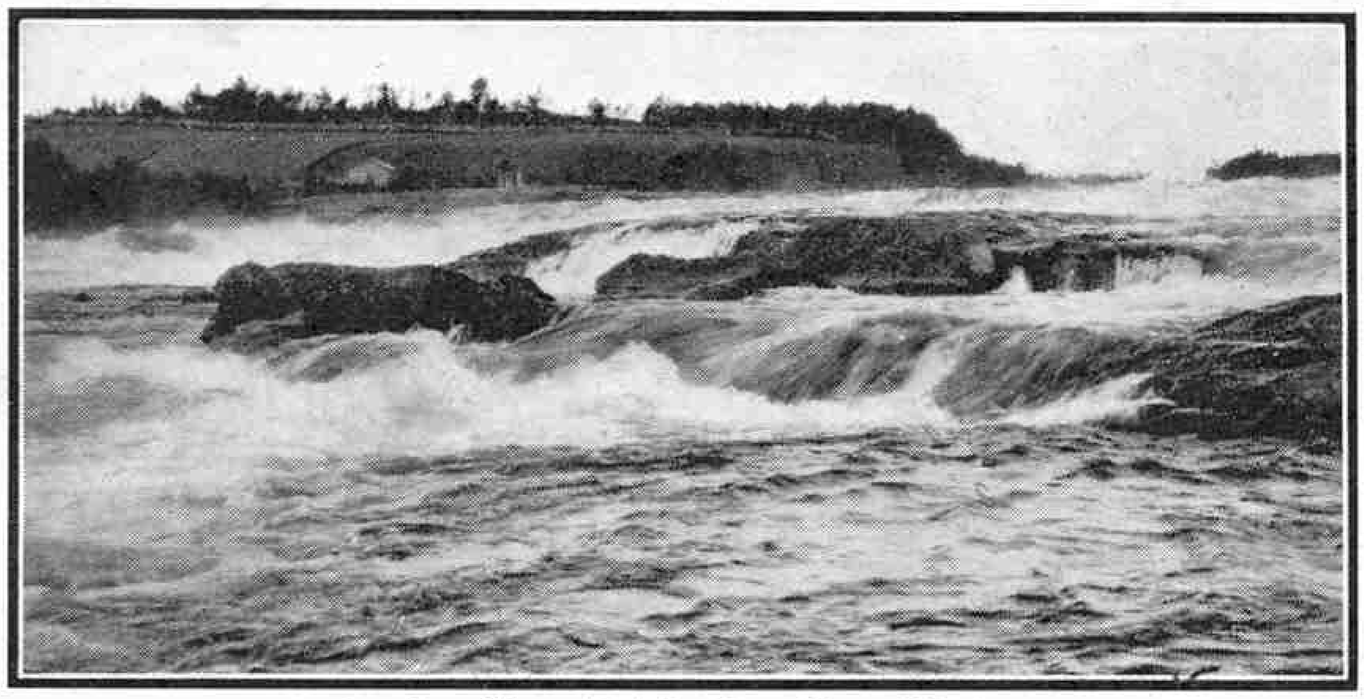
The turbines are direct-coupled to the alternators by means of vertical shafts, 85 ft. high. The alternators are three-phase machines each of 12,500 kVA capacity, and generate at 6,600 volts, 50 cycles. A lift provides communication between the turbine floor and the alternator floor.

The flow at Norrfors ranges from 1,600 cu. ft. per sec. to 88,000 cu. ft. per sec., and as there is no reservoir there it is not possible to impound the flow and use the water according to the varying demand for energy. At holidays and other slack periods when the demand is low the energy derived from the surplus water is transmitted to the Sillre plant, where it is used to raise water from the Indal River to a storage reservoir 650 ft. above the river level. By utilising in this way about 9,000,000 kWh of surplus energy a year from Norrfors, it is possible to obtain at Sillre an additional output of over 5,000,000 a year. Sillre is thus used as a peak and reserve power station.

Behind the first hills in the lower illustration on the next page there is a plateau with a system of lakes of which the three largest are regulated, giving a total storage capacity of 1,381 million cu. ft. The original level of the lower lake has been raised 13 ft. by the construction of a dam across the outlet from the lake. This dam permits a total of 18 ft., or approximately 706 million cu. ft., of

water to be withdrawn. The storage capacities of the other two lakes are 165 million and 510 million cu. ft. respectively, and the levels of these lakes are regulated by dams built to facilitate log-floating.

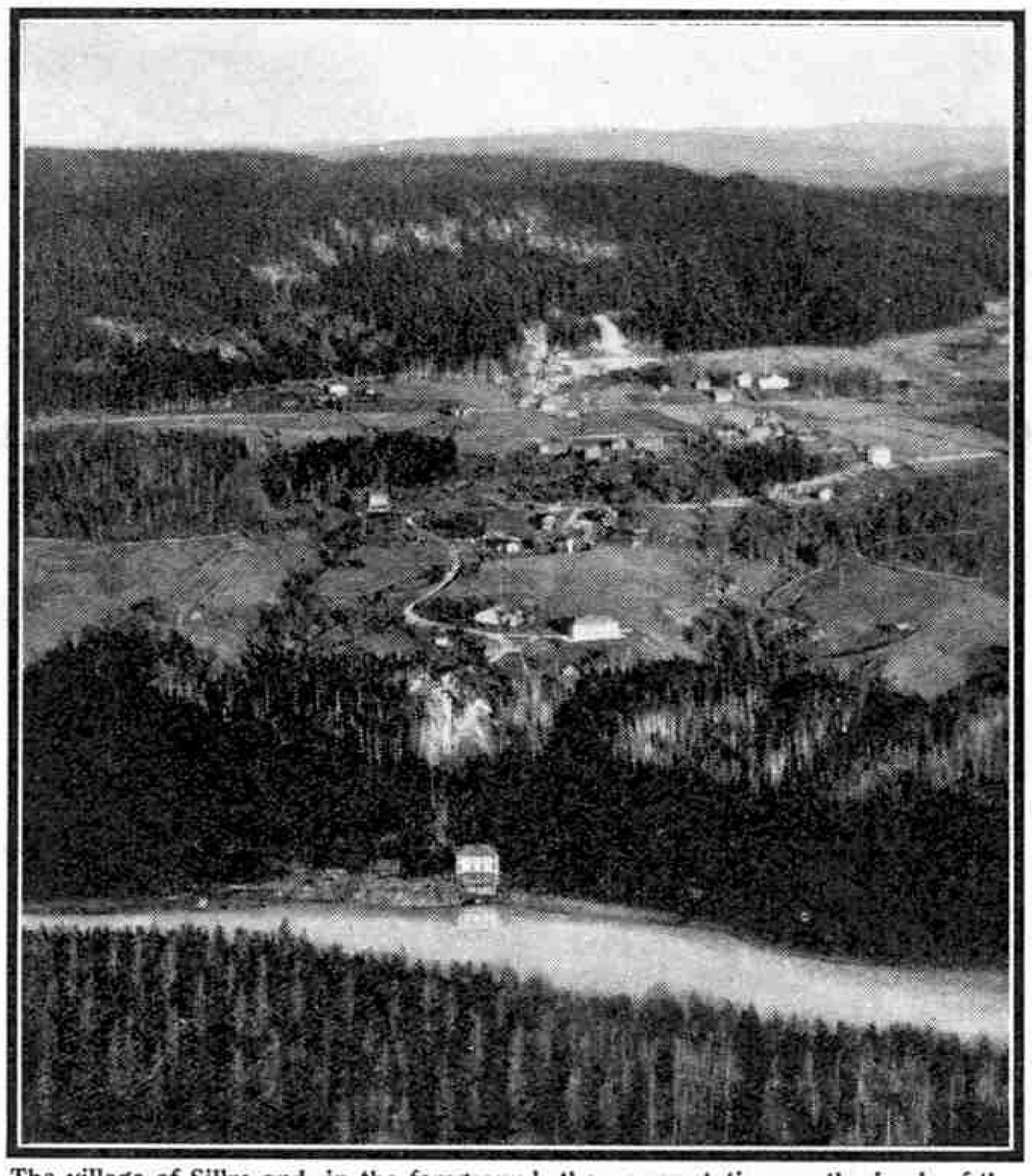
The regulation dam is of the rock-filled type and is 900 ft. long, and has a maximum height of 26½ ft. It has two outlets, both placed near the middle. One is for log-floating and is 13 ft. wide, and its depth is adjustable so that no more water than that required to float the logs can escape. The other outlet, for flood water, has an opening 4 ft. wide and 9 ft. high, and is provided with an ordinary sluice gate.



A section of the rapids in the Umea River, at Norrfors.

The diagram on the previous page shows how the water in the lakes is used by the Sillre station, 650 ft. below, before being allowed to pass into the Indal River. On leaving the lake nearest the power station the water enters a tunnel 6,500 ft. long and of a cross-sectional area of 54 sq. ft. that has been blasted through the hill. At the other end of the tunnel the water passes into a penstock 3,000 ft. long and of 6 ft. bore through which it descends to the turbines at the power station. At the junction of the tunnel and the penstock there is a butterfly valve to shut off the water supply to the penstock when necessary, and in an emergency this valve can be operated by push-buttons in the power station.

The upper part of the penstock passes through cultivated ground in the village of Sillre. It is laid in a cutting lined with concrete and covered over with earth. The bottom of the cutting is provided with a layer of stones to enable all ground water to drain away. Then for about 2,000 ft. of its length the penstock is laid in a steeply inclined tunnel blasted in the rock, and the space between the walls and the penstock is filled with concrete. Thus far the penstock is built up of steel plates only ¼ in. thick. This thickness is quite sufficient to withstand the water pressure in the upper, practically horizontal part of the penstock, but it would be most inadequate in the portion passing through the tunnel if it were not for the fact that the tremendous pressure of the water is transmitted through the concrete filling to the surrounding rock, which is of such a nature that it can easily withstand the pressure. The lower part of the penstock is in the open and is carried on cradles 20 ft. apart. It is of 4 ft. 10 in. bore, and is constructed of ⅞ in. steel plates.



The village of Sillre and, in the foreground, the power station on the bank of the River Indal.

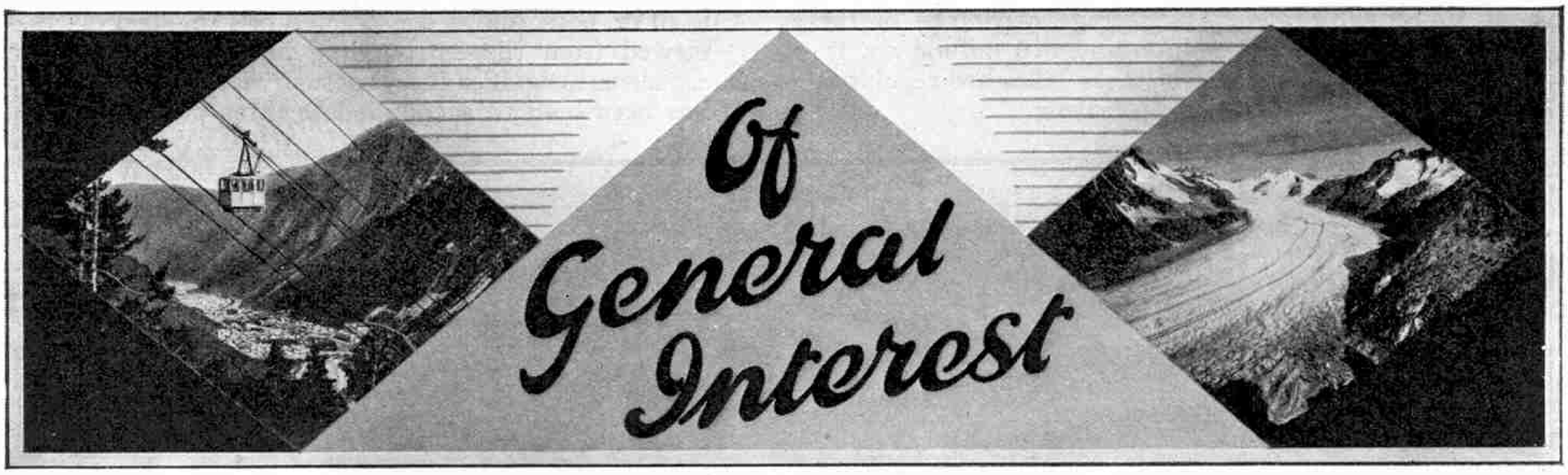
Viewed from the surrounding high hills the power house seems insignificant, but actually it is 90 ft. in height. It has been built to accommodate three power units, of 6,000 kW., 2,500 kW. and 8,000 kW. respectively, but at present only the 6,000 kW. set is installed. It consists of a pump, turbine and alternator operating on the same vertical shaft, and the other two units will be of the same type.

The lowest portion is the pump, which is of the two-stage centrifugal type, and is capable of raising 24,000 to 37,000 gallons of water per min. to a height of 750 to 600 ft. respectively, when operating at a speed of 600 r.p.m. The impellers are of cast bronze and 54 in. in diameter. The turbine that forms the middle portion of the unit has an output of 8,600 b.h.p. on a head of 600 ft., when running at 600 r.p.m. On a maximum head of 650 ft. it will develop 10,080 b.h.p. The runner is of cast bronze and is 50 in. in diameter. The turbine is provided with an oil pressure governor that keeps the speed constant at different loads. The upper part of the unit consists of a synchronous three-phase alternator of 7,000 kVA capacity, that generates at 6,600 volts, 50 cycles. It is provided with a water-cooled oil-lubricated thrust-bearing that carries a load of 55 tons, corresponding to the weight of the rotating mass of the whole unit plus the unbalanced hydraulic pressure on the pump impellers and turbine runner.

The outlet or regulating valve to the pump and the inlet valve to the turbine are both of the streamline type. These valves are hydraulically operated by means of a small servo-motor, the operating valve of which is actuated by a small electric motor, controlled by push buttons on the switchboard. These valves can be operated manually if necessity should arise.

The high efficiency of the power unit was demonstrated at the official tests, when the pump attained a maximum efficiency of 86 per cent. and the turbine of 91.6 per cent.

It might be imagined that the operation of such a large and powerful plant would require a large staff of attendants. The Sillre plant can be operated by one man, however, the opening and closing of all valves being effected automatically by push-buttons and relays.



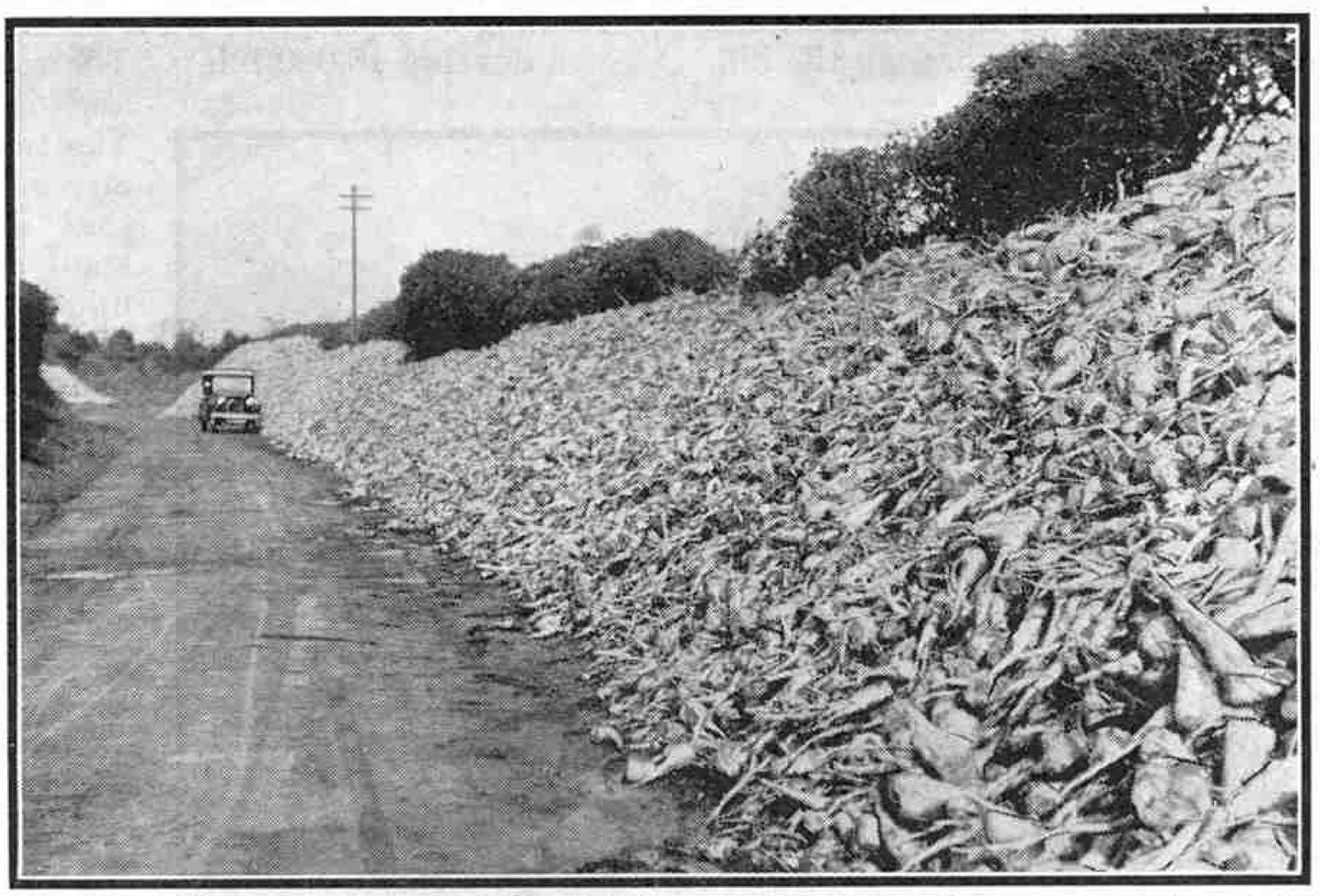
Where the Tides Begin

It is interesting to find that the tides that pile the water of the sea on our shores are now believed to start far away in the Pacific Ocean, which is the Earth's largest uninterrupted mass of water. If the Earth were uniformly covered with water, the great wave caused by the attraction of the Moon of course would simply travel directly round our globe from east to west, but the immense land masses of the continents get in its way and break it up into smaller wave fronts, so that actually tides may flow in from all points of the compass. The obstacles met by the wave also cause it to lag behind the Moon, the pull of which starts it on its long journey.

The tidal wave that reaches our shores passes the Cape of Good Hope about 20 hours later. The presence of the land mass of South America then bars its direct progress westward, and it travels up the Atlantic Ocean to Cape Clear, on the south-west coast of Ireland, where it arrives 16 hours afterwards. There it divides, a part passing on each side of Ireland. The two fronts enter the Irish Channel from the north and south respectively, and meet in Liverpool Bay.

The two parts of these tidal waves that are not diverted into the Irish Sea are separated by Great Britain, round which they curve to meet in the North Sea. This explains why the time of high tide is practically the same at Leith and London, while at Hull, approximately half way between the two, it is four hours later. The wave that brings high water to London Bridge left the Pacific 2½ days earlier, and actually it is a second wave, two days' old, that causes the flood tides at Leith and at Hull.

There are striking differences in the heights of the tides at British ports. Off the Ayrshire coast of Scotland the height is only 8 ft., but the tidal wave rushes up the funnel-shaped Bristol Channel to a greater height, sometimes reaching 33 ft. The greatest peculiarity of English tides is seen at Southampton, however, where there is in effect a double tide, one due to the arrival of the tidal wave flowing between the coast and the Isle of Wight, and the other to the passage of the wave up the Solent, after it has passed round the island.



Sugar beet awaiting transport by road and rail to the factory at Cantley, Norfolk, where the sugar is to be extracted from it. The great pile suggests the extent to which sugar beet is now grown in Great Britain.

The Hardest Metal Surface Known

I wonder how many of my readers know what is the hardest metal surface known to Man. Extraordinarily hard alloys of steel and iron have been produced, and these have been given remarkable wearing surfaces by various processes; but the hardest metallic surface of all is obtained by a simple process in which special irons and steels are treated with nitrogen in what is called the "nascent" state. This word simply means newly born, and describes a gaseous element at the moment when it has been liberated by the decomposition of a compound containing it. It is then far more active chemically than when collected and stored.

Steel acquires a very hard coating when heated with nitrogen newly formed in contact with it by the splitting up of ammonia gas. The process of nitriding, as it is called, is carried on at a temperature between 480 deg. C. and 650 deg. C., and the nitrided iron cannot be filed, and indeed is so hard that it will cut glass and scratch quartz. It is resistant to the corrosive action of air, steam and water and of course is not readily worn down by friction. The hardest part of the material is at the surface, but as the nascent nitrogen penetrates into the iron, the hard case is merged progressively into the softer core and there is no danger of the hardened surface peeling off.

Shall we ever be able to See Atoms?

There seems to be no limit to the efforts of scientists to probe more and more deeply into the mysteries of atoms and molecules. Until recently we were told that we should never see a molecule with the most powerful microscope, for light waves are too coarse to reveal such minute objects, even with the aid of the ultramicroscope, in which incredibly small particles are made to reveal themselves as tiny flashes of reflected light. So far all our knowledge of these tiny particles therefore has been obtained by indirect means, but it seems that now there is a possibility that we shall be able to photograph a molecule and so to study it directly.

The instrument with which this wonderful achievement may be made is called the electronic microscope, because streams of electrons are used in it instead of light rays. These streams are produced by the cathodes of vacuum tubes. They cannot be reflected by means of lenses, as light waves are, but their paths can be changed in a similar manner by means of magnets. This has been turned to good advantage in the electronic microscope, in which the electrons from any body emitting them are brought to a focus by passing them between the poles of an electro-magnet, which acts on them as a convex lens does on light rays. A photographic plate placed at the focus then records the appearance of their source, for the rays act as readily as light on the sensitive emulsion.

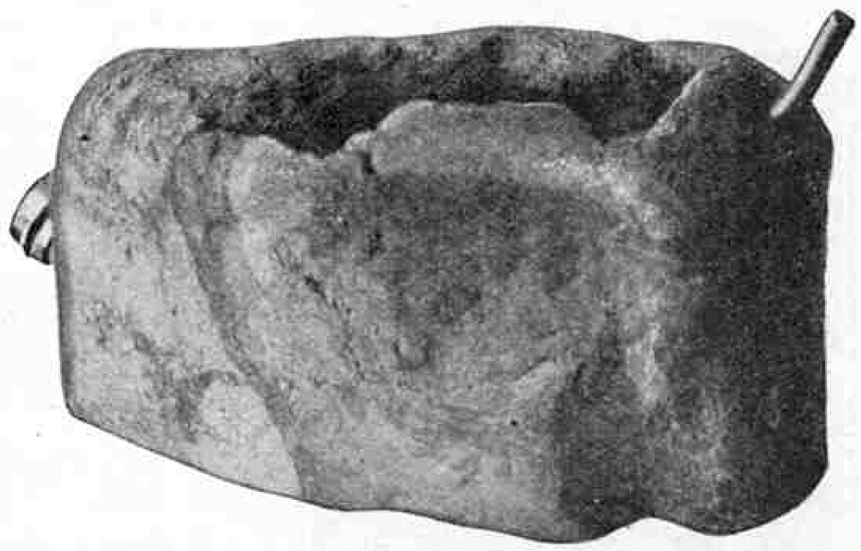
As yet the electronic microscope is in the experimental stage, but already photographs of incandescent wires emitting electrons have been obtained. The hot nickel cathode of a vacuum tube has been photographed in the same manner, and the individual crystals

of the nickel can be seen in the picture obtained. Possibly further experimental work will produce a microscope that will actually reveal to us the molecules and atoms of which the crystals are built up, although these are very much smaller.

A Crab that Wears Fur Gloves

Great concern has been caused recently in certain quarters by a threatened invasion of Great Britain. The prospective invader is only a crab, but its appearance in this country is dreaded because it carries with it a parasite that is responsible for an unpleasant lung disease that affects man and domestic animals.

The creature is about the size of an ordinary shore crab, and is known as the woolly-clawed crab, or the mittened crab, because it has a little brown pad of velvet-like material on its fore claws. Its home is in the estuaries and rivers of China and Japan, but it has spread to Europe, probably in the water ballast tanks of ships. It appeared in the River Elbe about 20 years ago, and has now reached Holland, which is uncomfortably near our own shores. Although the prospect of an outbreak of the disease associated with it may be remote, its presence is undesirable because of its menace to fisheries, for it feeds ravenously on the crustacea and other tiny creatures that form the natural foods of fishes, and increases at an astonishing rate when established in the congenial surroundings of estuaries and the lower reaches of rivers.



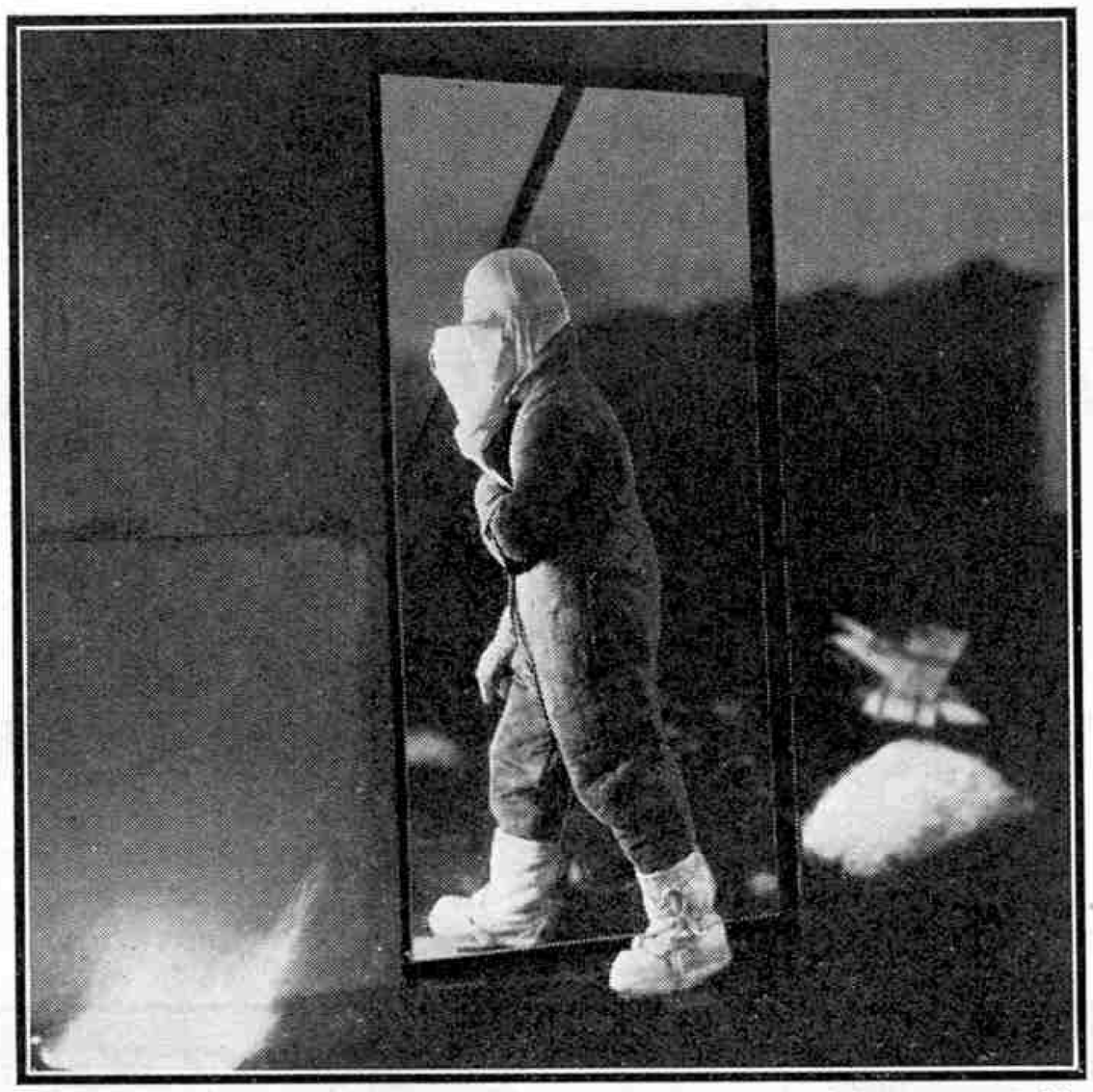
A block of papier mache found inside a "K" oil can that had been used in a paper mill.

Fireproof Gloves and Clothing

The middle illustration on this page shows a man wearing an asbestos suit, about to enter a burning building. The wonderful material of which his clothing is made gives him complete protection, for in addition to being non-inflammable it is a non-conductor of heat. Asbestos is a complex mineral found in Canada, Australia, South Africa and other parts of the world. It contains fibres that can be separated and after special treatment woven into a soft fabric that is completely indestructible by fire. It is a curious fact that asbestos contains magnesium, a metal which in the form of wire or ribbon, burns fiercely with a brilliant white flame when ignited.

In the illustration here reproduced, the man entering the burning building is protected by a suit, gloves, boots and helmet, all made of asbestos. Thus he is completely enclosed and can safely remain for a minute at temperatures up to about 1,500 deg. F. without special breathing apparatus. The illustration on the Editorial Page of this issue also shows in a striking manner the protective value of asbestos. The girl shown has scooped up white hot coals from a furnace and is holding them in the palm of her hand without the slightest danger or discomfort, thanks to the asbestos glove that she is wearing. The glove shown is the Bestobell "Bellmunn" made for the Royal Air Force by Bell's Asbestos and Engineering Supplies Ltd., and is so efficient that its wearer can take red-hot bars in his hand and hold them until they are cold. At the same time the glove is sufficiently flexible to enable its wearer to pick up between the thumb and first finger such articles as drawing pins laid on the floor. Gloves of this kind may help to save the lives of airmen trapped in aeroplanes that have crashed and caught fire.

Many other uses have been devised for asbestos in connection with fires and fireproofing. A small fire can readily be put out by enveloping it in an asbestos blanket, and firemen can use asbestos shields to enable them to approach burning buildings in comfort and remain there for considerable periods. Rooms protected by asbestos sheeting can be regarded as fireproof. In a test of the efficiency of asbestos for this purpose, a small wooden building of two rooms was erected. One of the rooms was completely encased in asbestos sheet, and remained intact when a fire was lit under the rooms, although the one that was not protected in this manner burned so furiously that it was completely destroyed by the flames.

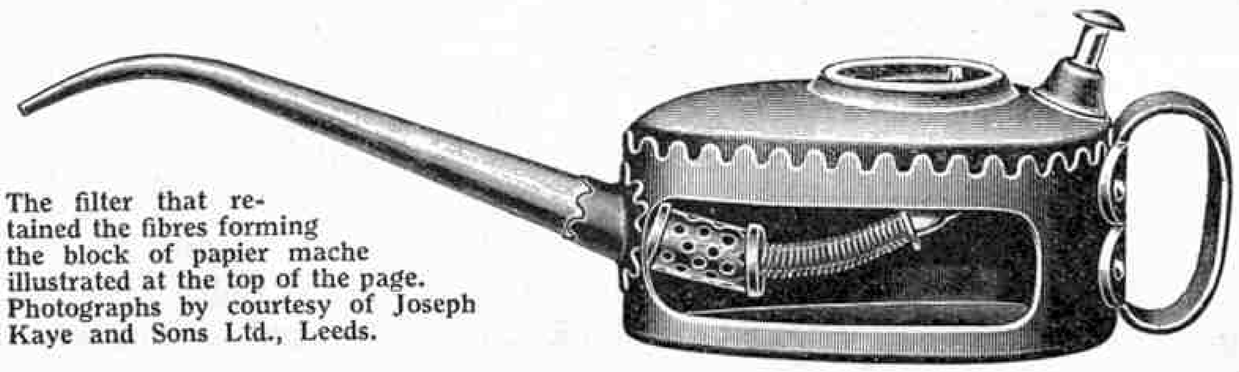


Man wearing an asbestos suit, with boots, gloves and helmet of the same material, entering a burning building. Photograph reproduced by courtesy of Bell's Asbestos and Engineering Supplies Ltd.

A Discovery in an Oilcan

The importance of filtering oil before passing it into the bearings of machinery was demonstrated recently when an old oilcan that had been in use for many years at a paper mill was returned to the makers for cleaning and repair. The oilcan was one of the well-known "K" type made by Joseph Kaye and Sons Ltd., Lock Works, Leeds, and was fitted with their special filtering device. When the oilcan was examined it was found that the whole of the interior was completely filled with solid matter held back by the filter, which otherwise would have passed with the oil into the machines. The retained matter consisted principally of paper pulp, and formed the hard papier mache block illustrated at the top of this page. Other oilcans of this type received back from the mills for cleaning and repair also were found to contain a certain amount of the paper pulp. If all this foreign matter had been allowed to pass into the bearings of the great paper machines a considerable amount of damage might have been done.

The oilcan concerned has been in use for many years, and the illustration at the foot of this page shows the design of the can and filter, which has so clearly proved its value where there is a possibility of dirt, dust, or other foreign matter entering the can and mixing with the oil. As my readers know, the familiar Meccano Oilcan is a miniature reproduction of the "K" type oilcan, but has no filter, which is unnecessary and would be impracticable on such a small scale.



The filter that retained the fibres forming the block of papier mache illustrated at the top of the page. Photographs by courtesy of Joseph Kaye and Sons Ltd., Leeds.

Wasps sent across the Atlantic Ocean

Few people show great anxiety to become the possessors of a swarm of wasps. At first sight, therefore, it is surprising to find that the Canadian Government recently took the trouble to import a large consignment of live wasps and larvæ from Izsak, a village in Hungary, and even arranged air transport for part of the journey of these insects from the Old World to the New. The apparently strange desire to own as many wasps as possible seems to have caused great excitement in Izsak.

The reason for this desire for Hungarian wasps is that the insects are a black, long-winged variety with a great liking for the tsetse fly, the carrier of sleeping sickness. They have already done excellent work in exterminating this fly from certain districts in Canada, and next summer a wasp farm is to be organised at Izsak on behalf of the Canadian Government.

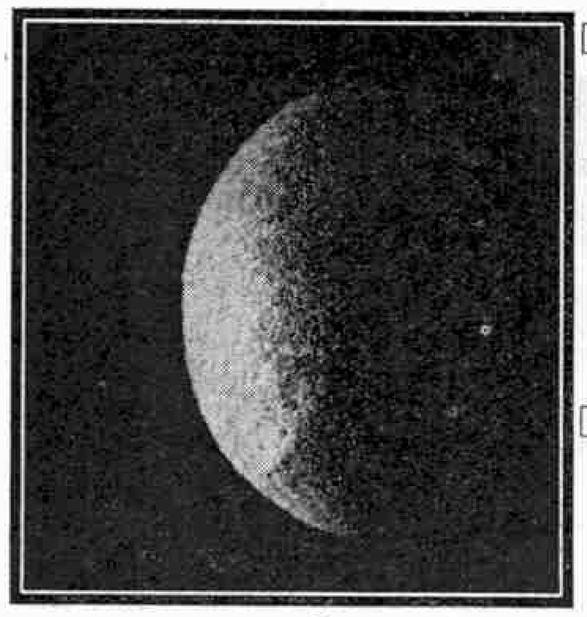
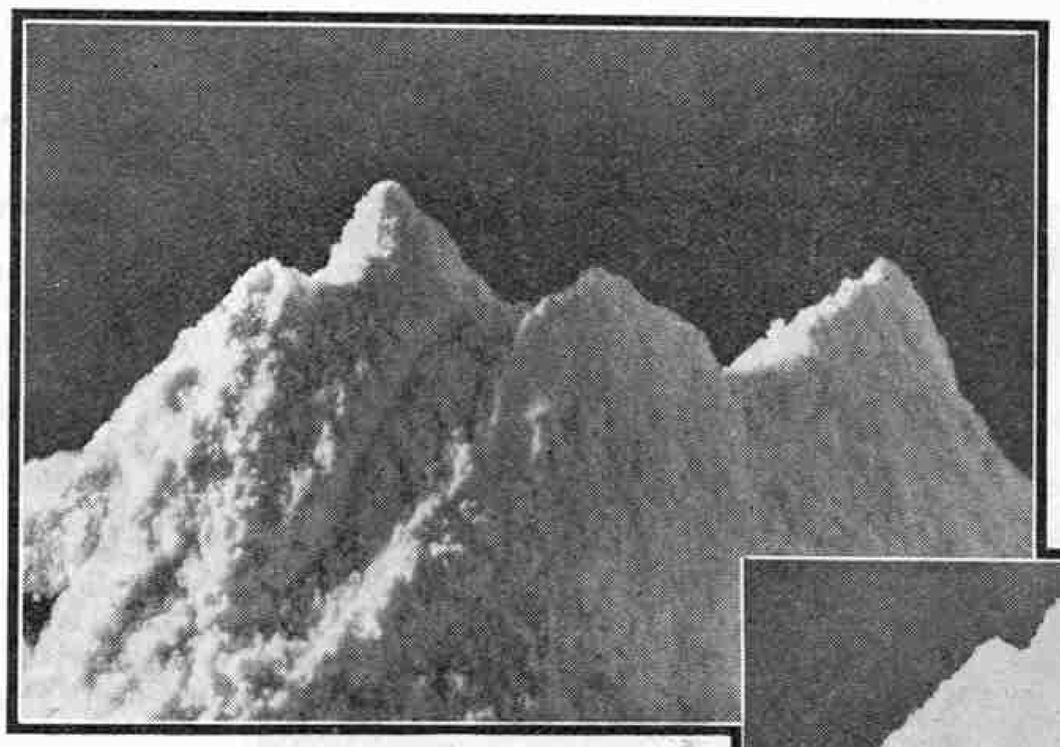


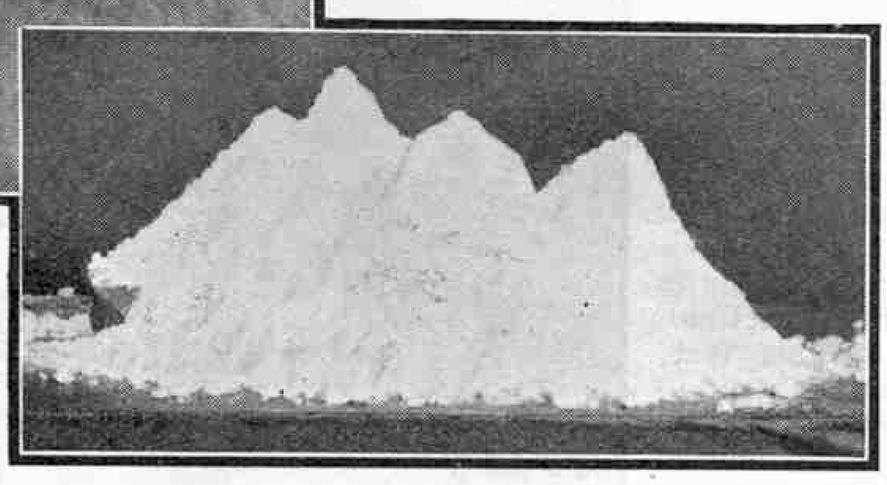
Table-Top Photography

Some Hints on a Fascinating Hobby

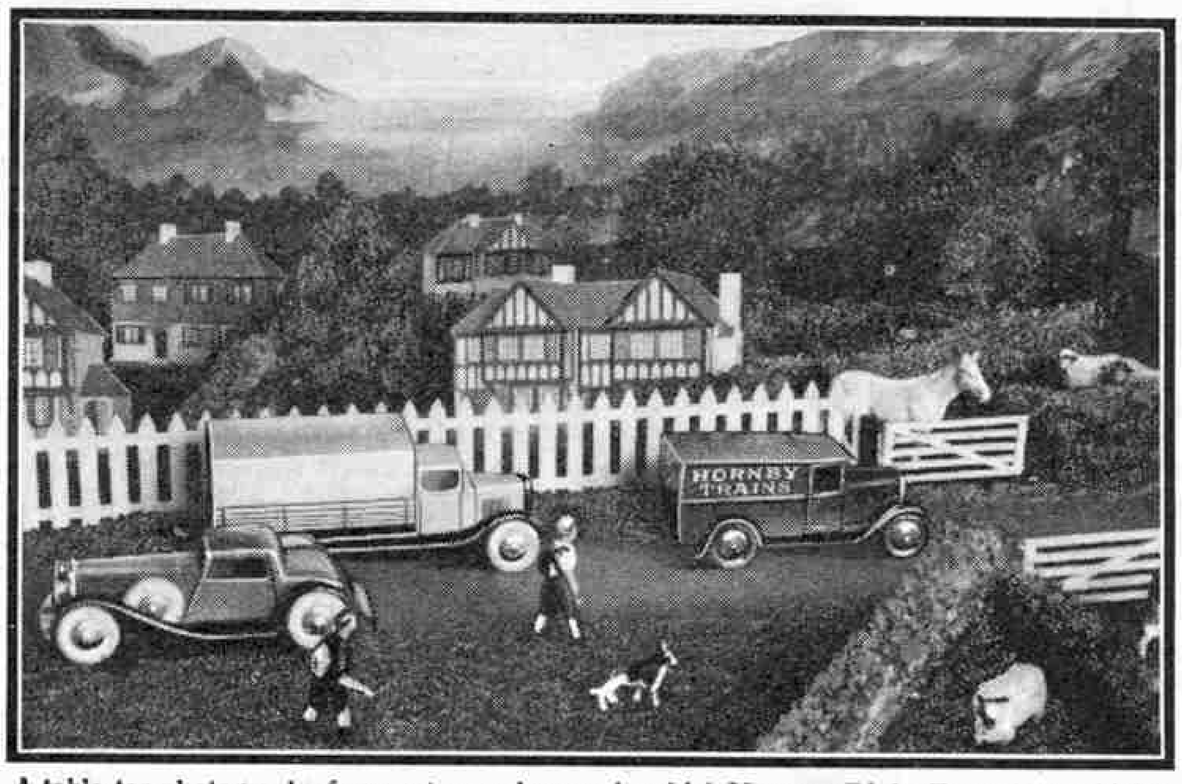
THE most remarkable feature of photography as a hobby is its enormously wide range. It can be practised all the year round, indoors as well as out in the open, and there is practically no limit to the variety of subjects.

Of the many indoor branches of the hobby, table-top photography is one of the most fascinating. It consists of arranging miniature scenes in such a manner that photographs of them appear to have been taken from life. It is easy to build up realistic scenes from simple materials that are available in every home. A lump of coal and some sand, for instance, make a very real-looking mountain; while a few carefully selected twigs, with leaves if it is a summer scene, or without leaves for a winter effect, provide trees and hedges. A rocky mountain path can be represented realistically with small pieces of stone or brick and sand, and a country roadway with brown paper and sand. Sawdust dyed green with ordinary clothes dye can be used for grass, and cotton wool suitably coloured makes excellent hedges. These few examples will serve to indicate the possibilities of scrap materials in the hands of an ingenious boy or girl, and it is great fun to experiment with different substances and compare the results obtained.





This striking view of a snow-covered mountain consists of nothing more than a heap of alum, arranged as shown on the right, and suitably lighted. A tennis ball placed against a black background, and illuminated from one side, provided the photograph of the crescent moon shown at the head of this page. These "moon" and "mountain" photographs are by Mr. H. Bastin, of Reading.



A table-top photograph of a country road scene, in which Meccano Dinky Toy motor vehicles and animals are used to good advantage.

The most important point to remember in arranging a scene is that all the models and component parts must be in keeping with the general scale of the scene. The whole effect will be spoiled if the resulting photograph shows, for instance, a horse twice the size of a motor car, or a man standing in front of a house that is less than his own height! However attractive a particular item may look, it must not be included if it is out of scale. It is easy to go astray on this point, and it is advisable to pay great attention to securing good proportion between the various parts of the picture.

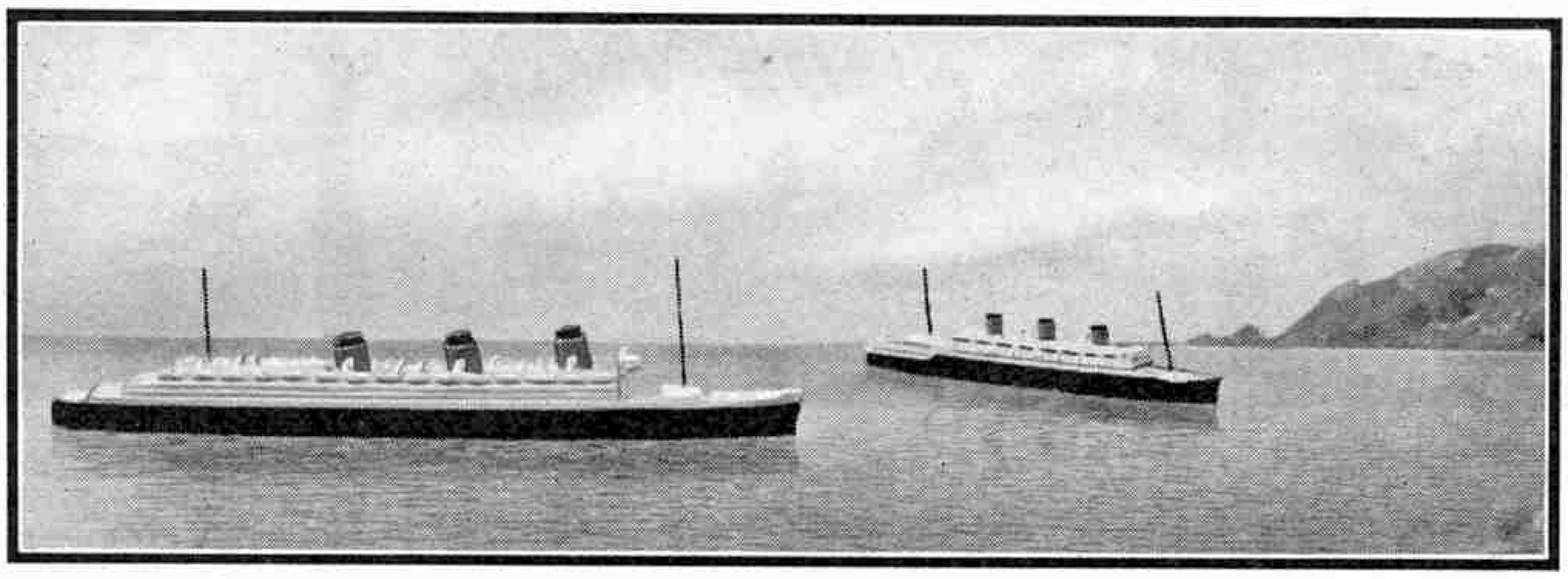
One of the great difficulties of table-top photography in the past has been that of obtaining models small enough for the purpose. Now, however, owing to the introduction of Meccano Dinky Toys, this difficulty no longer exists. These splendid little miniatures are available in such a wide variety of subjects, and are so realistic in detail, that they supply at once the needs of most table-top photographs. The Dinky Toy motor cars and wagons lend themselves perfectly to the production of realistic road scenes; the trains provide material for railway photographs, and the liners and war vessels make it possible to produce harbour and coastal scenes in great detail. The aeroplanes, too, can be used to produce remarkably realistic flying scenes. An illustrated list of the various Meccano Dinky Toys should be obtained from a Meccano dealer so that the range of subjects can be seen at once.

Some kinds of table-top photographs do not require the use of models, and a good example of this type is the accompanying "sunrise on the mountains" picture. This very striking scene consists of nothing more than a carefully arranged heap of alum placed on a small stage with a dark cloth for a background. The "mountains" were illuminated by burning a piece of magnesium ribbon at a suitable angle to produce the required lighting effect. Another example of a similar kind is the photograph of the crescent moon shown in the heading to this article. This is simply a photograph of an ordinary tennis ball. The ball was set up against a black backcloth and illuminated

from one side by burning magnesium ribbon.

It must not be thought that it is necessary to be an expert photographer, or to possess an expensive camera, in order to indulge successfully in table-top photography. It is possible to produce splendid results with a small film camera, and indeed the main advantage of a more costly camera is that it simplifies the operations involved.

An essential requirement for most table-top scenes is a stage or baseboard, which should be about 3 ft. by 2 ft. A cardboard background of the same size will also be necessary. For pictures of interiors the background may consist of a piece of buff-coloured cardboard on which is drawn or painted a simple sketch representing the wall of a room. For outdoor scenes a simple picture consisting of trees and hills is the most suitable. The stage or baseboard should be tilted slightly so that the rear is a little higher than the front.



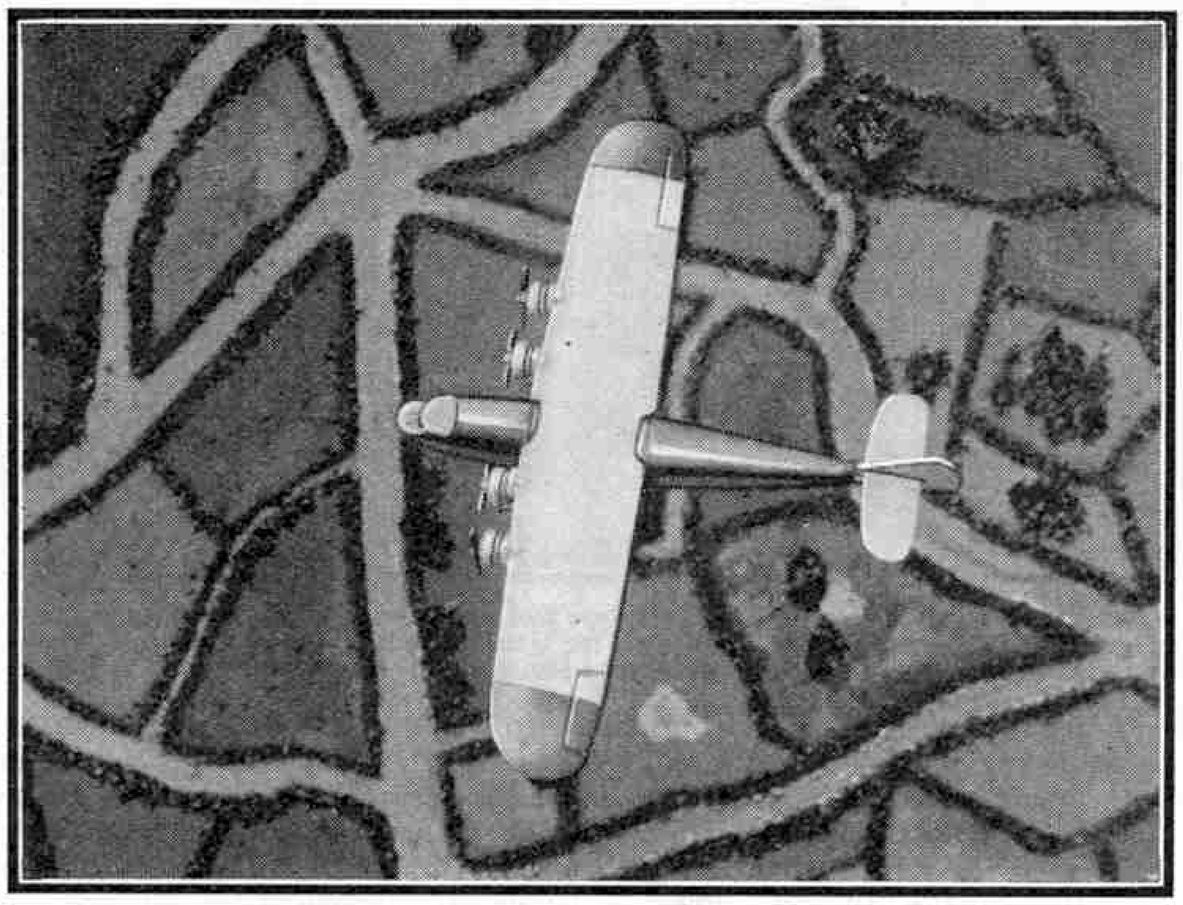
This photograph is a good example of the way in which the Meccano Dinky Toy liners can be used to produce realistic river and harbour scenes. The Cunard White Star "Queen Mary" is shown at anchor in the foreground.

In regard to the camera, the possession of one fitted with a focussing screen is a decided advantage in this class of photography. Accurate focussing is very important, and with a camera of this type the photographer is not only able to ensure that his picture is sharp, but also is able to study the general arrangement of the scene with greater ease than can be done with a non-focussing camera of the folding film or box type. To ensure a good sized picture that covers the plate or film, it is essential that the camera should be brought near the subject. This means that a camera fitted with double extension bellows that will rack out sufficiently to allow close-up work is the ideal instrument for the purpose. With a box form or other non-focussing camera, a supplementary lens or "portrait attachment" must be fitted to the ordinary camera lens. Such attachments bring objects at close range into sharp focus, and are readily obtained at small cost. Whatever type of camera is used, the best results will be secured by using a lens aperture of F/32 or even F/64.

One of the most important features in ensuring successful table-top photographs is good lighting. This requires careful arrangement, and conditions vary so much that only a few hints can be given here. If a scene is to be photographed indoors by daylight, the stage should be placed close to a window in such a position that the light comes from the side and slightly in front. When the photograph is to be made by artificial light, it is best to place the stage almost directly underneath the main light, and to have a second and rather less powerful light to one side and slightly in front of the scene, in order to avoid flat and uninteresting lighting. Shadows cast over the scene will subdue its boldness. A few experiments with different arrangements of lighting will provide a useful guide for future operations.

It is not possible to give definite instructions in regard to the length of exposure required, as this will vary according to the lighting conditions and other matters. Daylight is very variable, and it is best to work out the exposure with an exposure meter or calculator. The Wellcome or Imperial calculators are particularly useful for this purpose.

A good example of the use of Meccano Dinky Toys in table-top photography is shown in the lower photograph on the opposite page. In this case the materials were placed on a small card table about 2 ft. by 2 ft., and the background consisted of a sheet of white cardboard about 2 ft. long and 1 ft. wide, on which mountains and seas were roughly drawn in with grey, blue, and green paint. In making a background of this kind it is not necessary to put in fine details; indeed, the broader the effect the more realistic will be the resulting photograph. The houses shown in the picture are coloured illustrations of dolls' houses taken from a toy dealer's catalogue. The illustrations were cut out and glued to pieces of thick cardboard, and fitted with cardboard struts so that they would stand upright.



Aerial photographs of this kind are easy to arrange with the aid of Dinky Toy Aeroplanes. The manner in which the photograph was produced is explained in the accompanying article.

The fields were made up from Hornby Countryside Sections with a number of Hornby oak and poplar trees massed together in the background. Readers who do not possess any Countryside Sections will find that a good substitute is provided by a sheet of brown paper lightly sprinkled over with sawdust dyed green. This makes a very realistic field, and in the scene we are now considering the method was adopted for making the grass verge in the foreground. Dinky Toy motor vehicles, hikers, and animals complete the materials used in the picture.

The photograph was taken with a quarter-plate camera fitted with a focussing screen and double extension bellows. The camera was placed about 3 ft. from the scene, and a little to one side so that an angular view point was obtained. It was also placed a few inches above eye level and tilted slightly so as to look down on the scene. For focussing, the words

(Continued on page 94)

A "Meccano-Built" Aeroplane

A new aeroplane that has recently been produced is described by *"Flight,"* one of the leading technical aeronautical journals, as being built on the "Meccano" system of construction. The machine is a low wing two-seater cabin aeroplane and is known as the Martin-Baker MB1. The unique feature of its construction lies in the fact that it is built of numerous small pieces of tube that are bolted together so that in the event of damage, or for any other reason, any of these pieces can be replaced with little difficulty.

An interesting method of joining the tubes together in the after portion of the fuselage has been developed. The two ends of the joint are pushed together, one slipping inside the other so that two holes in the outer one coincide with tapped holes in the liner. These are provided with nuts brazed to the inner surface of the tube, and the tubes are joined together by a stud that is screwed through, and on the end of which a washer is placed. The stud is made long enough for other struts to be bolted on to the end of it if necessary.

The MB1 is 28 ft. 10½ in. in length, 37 ft. in span, and 13 ft. 2 in. in span when folded ready for housing. Details of its performance are not yet available, but we hope to publish them, together with a fully detailed and illustrated description, in an early issue of the *"M.M."*

American Transoceanic Flying Boat

Pan-American Airways, the well-known American air line company, have recently equipped a Sikorsky flying boat for service to train pilots for long-distance ocean flights. The boat has been provided with additional fuel tanks that give it a range of 3,000 miles, in addition to a special fuel pumping feed, two-way radio and a direction finding device. At first flights will be made over well-known routes, but afterwards the boat will be taken to the Pacific coast of America. After this the boat will be used for experimental work in connection with a service across the Pacific from America to the Phillipines and China that it is hoped to inaugurate in the very near future.

A Two-Stroke Aero Engine

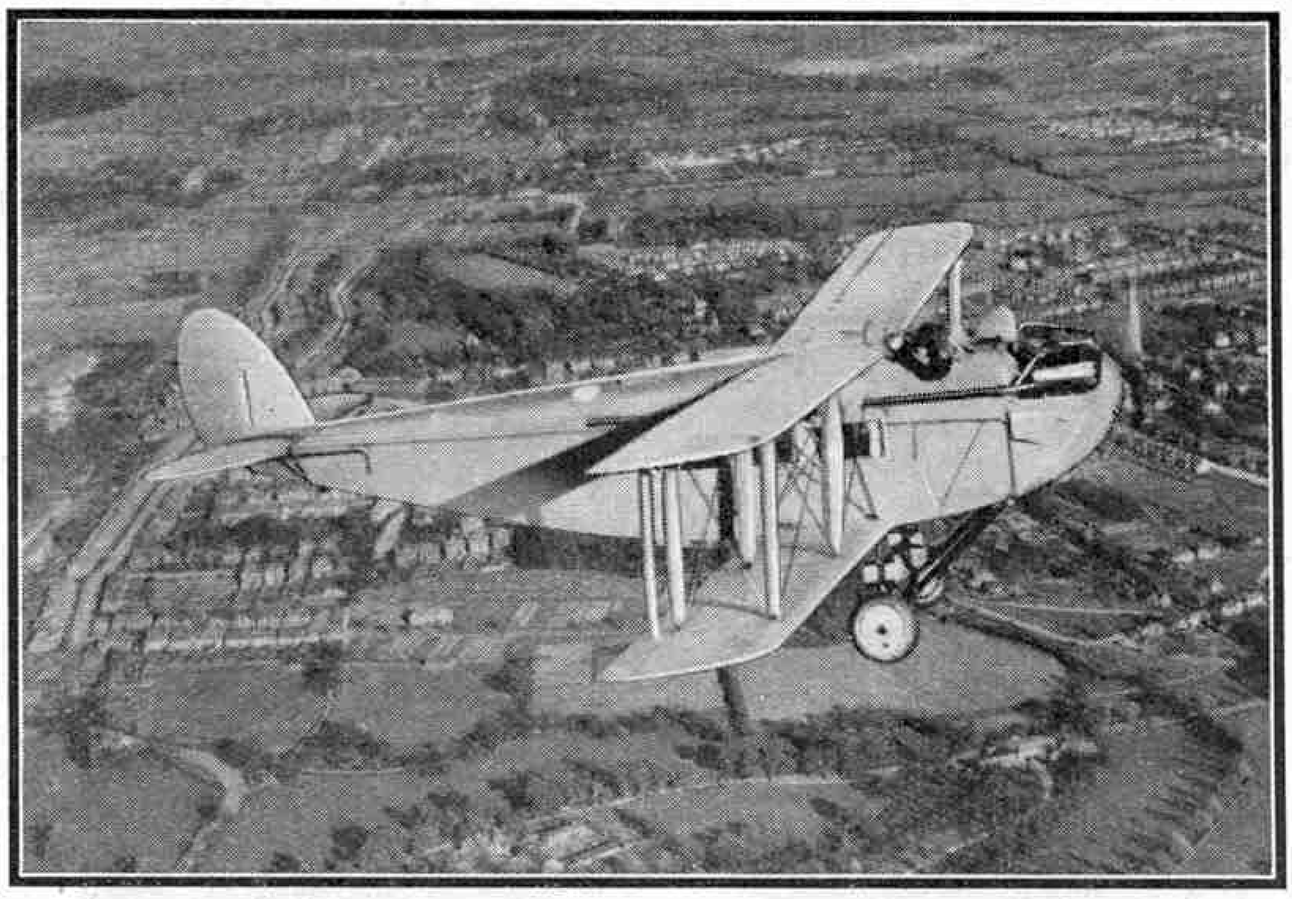
A novel two-stroke aero engine is now being produced by a British firm known as Remtor Ltd. The engine, which has been named the Remtor "Meteor," is of the eight-cylinder air cooled radial type and develops 50 b.h.p. at 2,500 r.p.m. It weighs 200 lb.

The engine is arranged so that the cylinders are gas-tight at both top and bottom. The mixture is fed through a passage in the crankcase to a compression chamber in the cylinder below the piston, the ports admitting it being open at the top of each stroke. As the piston makes its downward stroke, compressing the gas, the ports are closed, but when the piston is near the bottom it opens another port and the compound mixture escapes through a passage in the wall of the cylinder to the compression chamber above the piston. Here it is ignited in the normal manner. Every down stroke is, of course, a working stroke.

Touring by Mixed Transport

Long-distance pleasure trips during which tourists will travel by air-liner, ocean-liner, river-steamer, and motor-car, are now being organised on a much larger scale than ever before.

One such excursion, providing 10 days in the big-game country of Central Africa, left New York a short time ago. After their liner voyage across the Atlantic, the tourists called at Gibraltar, Naples and Alexandria. Then, after a series of sight-seeing tours from Cairo, they left Cairo in one of the air-liners of Imperial Airways, flying via Khartoum to Nairobi, and obtaining wonderful bird's-eye views while in flight of the scenery and wild life below. From Nairobi they made a tour by motor-car through the big-game country. The trip back to Cairo was made in one of the Nile steamers, and the return to New York by a liner boarded at Naples.



A D.H.34 air liner in flight. This machine is of a type that was extensively used by Imperial Airways several years ago and should be compared with the latest Imperial Airways machines illustrated in recent issues of the "M.M." Illustration by courtesy of de Havilland Aircraft Co. Ltd.

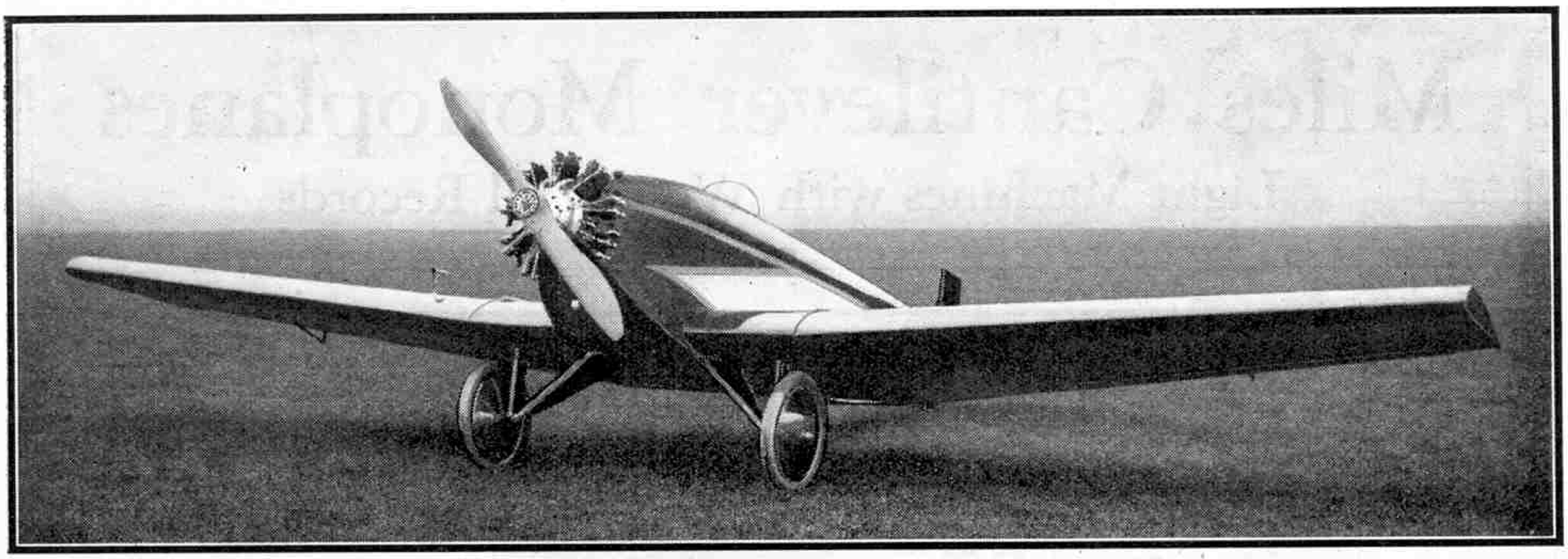
Races Round the World

The great interest aroused by the MacRobertson air races from Mildenhall to Melbourne has shown that such long-distance contests appeal to the public imagination, and in addition are valuable to the aircraft trade in stimulating sales. It is now stated that a French paper has decided to organise an air race round the world in 1936. No details have yet been issued, but if the race takes place it will probably start at Paris, from where the course will lead to Japan and on to San Francisco. Here some of the machines will probably travel to Africa by way of Central America, and then back to Paris, while the others will reach Paris by way of New York and the Atlantic Ocean.

A suggestion has also been made that, to commemorate the improvements and erection of new buildings at the Liverpool Aerodrome at Speke, a race around the world should be organised by a Liverpool newspaper. Details of the proposed course cannot yet be given, but will be published as soon as possible, if the scheme is proceeded with.

New Names for Bombing Aircraft

The classification of R.A.F. bombers under two general types, day and night bombers, is to cease, four new names having been decided upon. Machines similar to the Hawker "Hart," for instance, will in future be termed Light Bombers; those similar to the Boulton and Paul "Overstrand," Medium Bombers; those similar to the Handley Page "Heyford," Heavy Bombers; and those similar to the Vickers "Vincent," General Purpose Bombers.



A Farman F-360, one of the most successful French light two-seater aeroplanes. It is equipped with a 40 h.p. Salmson engine and has a maximum speed of 112 m.p.h. A striking feature of the machine is the "square" wing tip typical of Farman construction. Photograph by courtesy of Avions Henri et Maurice Farman.

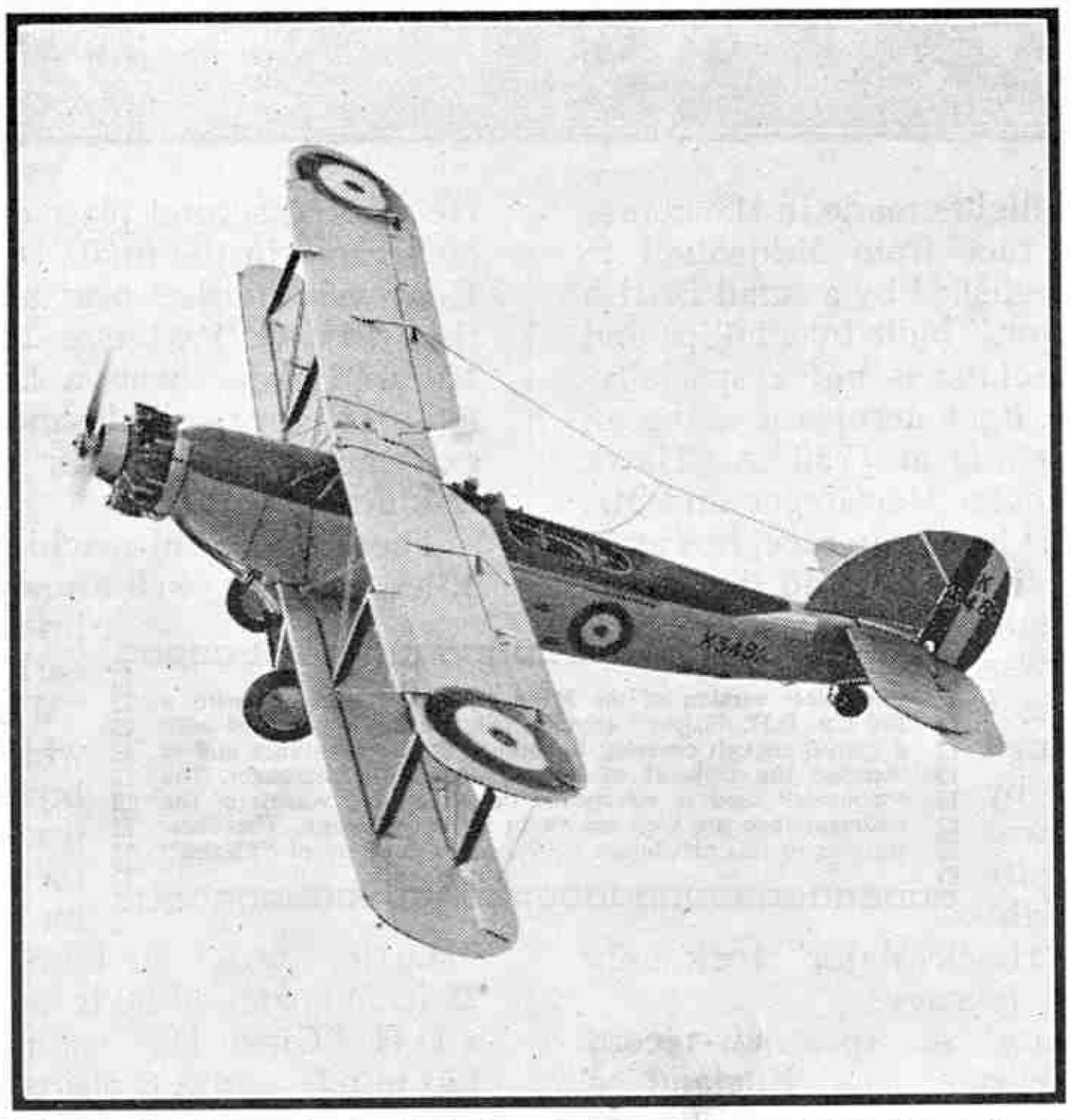
Improvements to African Aerodrome

Work is now nearly finished on the new airport buildings at the Rand Air Port, Germiston, near Johannesburg. The main building that is being constructed contains separate Customs, immigration, health, traffic and Post Office sections, and there are in addition three separate waiting-rooms for passengers, a large restaurant, airport administration offices, board room and control tower. This building is costing approximately £22,000.

The roof is flat and provides seating accommodation for 5,000 people, who are thus able to view flying displays in comfort. The building is fitted with a "public address system" that enables the traffic officers and other officials to hear in their own offices the announcements made by the control officer. The control tower is connected directly with the wireless station of the airport, which obviates the present necessity for all messages to come through the Germiston Exchange. The wireless masts are situated well away from the control tower and landing area.

An airman's clock that is probably the largest in the world is installed in the front of the building, and a loud-speaker telephone has been constructed on the arrival and departure platform to enable pilots to speak direct to the control officer practically from the control cabins of their aircraft.

The Government have decided to build a new meteorological station next to the administrative building.



A Fairey "Seal" aeroplane in flight. The wireless aerial connected to the wings and the rudder can be seen. Photograph by courtesy of "Flight."

Empire Air Services Now Duplicated

The weekly services on the India and Africa air-mail routes have now been duplicated. The effect of this is to give a twice-weekly service in each direction between Great Britain and Palestine, Iraq, the Persian Gulf, India, Sudan, Uganda, Kenya, Tanganyika, North and South Rhodesia, and the Union of South Africa; and four return services weekly between Great Britain and Egypt, which is served by both the India and Africa routes. The duplication on the India route is operative between London and Calcutta, and that on the African service between London and Johannesburg.

The first duplicate service from London for Johannesburg left the Croydon airport on 30th December last, with departures each Sunday and Wednesday thereafter. On the Indian route the first duplicate service for Calcutta departed from London on 1st January, subsequent departures being on Tuesdays and Saturdays.

As a result of these duplications very considerable savings will become possible in the time required to send letters to and from destinations along the Empire air routes. At present letters from India arrive in London on Monday, and by the weekly service no answer can be despatched until the following Saturday. With the establishment of the duplicated service it will be possible to reply by the air-mail leaving London for India on Tuesday—a saving of four days.

In regard to Johannesburg, letters arrive there at present each Thursday by the weekly service from London, and there is no return service until the following Wednesday. With the institution of the duplicated service it will become possible to catch a return air-mail to London each Saturday, also representing a saving of four days.

Big British Air Mail Speed-Up

According to a speech made in the House of Commons a short time ago by Sir Philip Sassoon, the Under-Secretary of State for Air, extensive speed-ups and alterations are to be made on the Empire Air Services.

Sir Philip stated that it was hoped that soon Imperial Airways machines would operate a service to India in just over two days, while 2½ days would be occupied to East Africa, four days to Singapore and seven days to Australia. The services would also be much more frequent, four or even five machines being timed to depart every week to India, three every week to Singapore and to East Africa, and two to South Africa and Australia. The scheme outlined also provides for extensive development of the ground organisation so that it will be possible for both passengers and mails to travel by night.

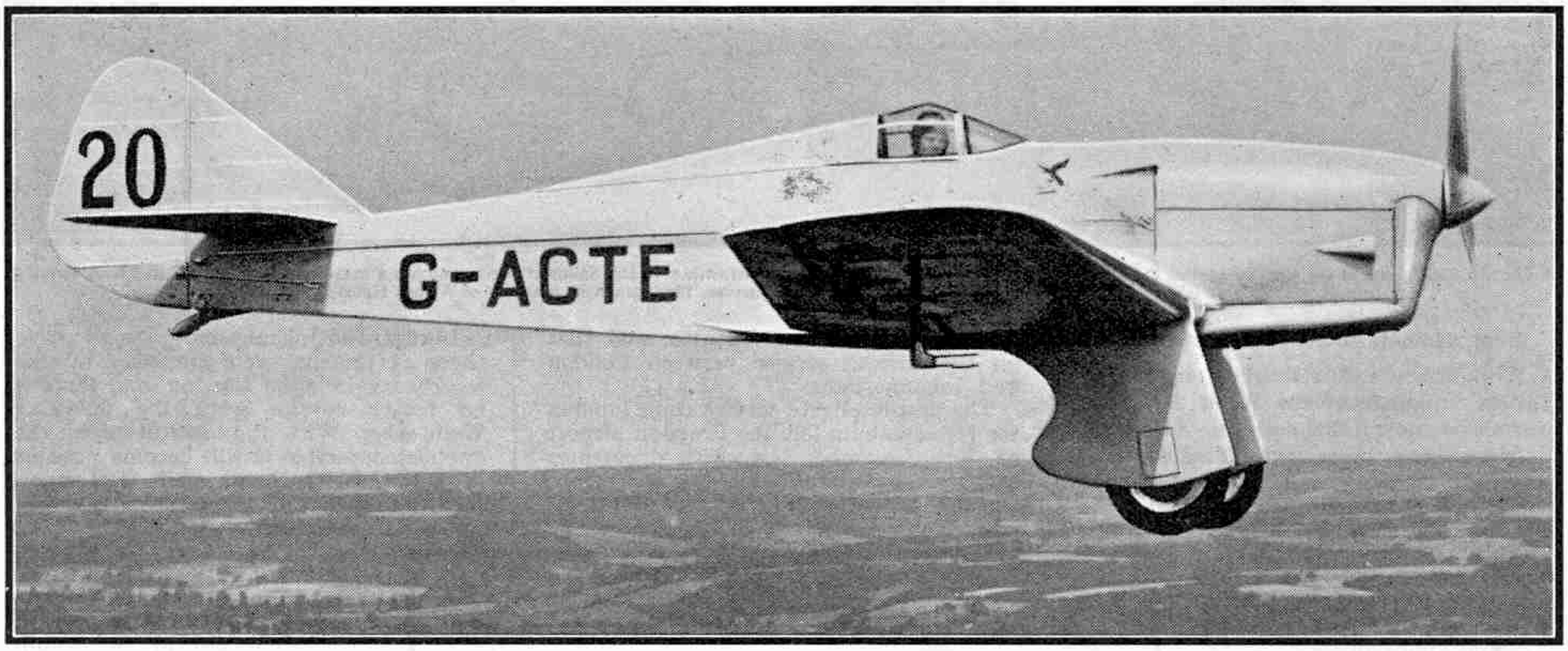
Another important section of the scheme is that all first-class postal matter will be carried by air, the cost of sending this being reduced to about 1½d. per half ounce to anywhere in the British Empire. This compares favourably with the present rate of 1/3 per half ounce for matter going by air to Australia, for instance. It will not be possible for many of these postal improvements to be put into effect until the beginning of 1937.

The Farman F-360

The Farman F-360, illustrated at the top of this page, is one of the most successful French light two-seater aeroplanes. It is the smallest machine in the Farman range, measuring only 30 ft. 7 in. in span and 18 ft. 4 in. in length. It has a maximum speed of 112 m.p.h. and cruises at 96.4 m.p.h.

Miles Cantilever Monoplanes

Light Machines with Wonderful Records



The latest version of the Miles "Hawk," equipped with a 200 h.p. D.H. "Gipsy" engine. This version is equipped with a special cockpit covering to reduce the air resistance and to increase the comfort of the pilot and his passenger. The "trousers" used to streamline the struts and wheels of the undercarriage are well shown in this photograph. The illustrations to this article are published by courtesy of "Flight."

ONE of the most wonderful flights made in the course of the MacRobertson air race from Mildenhall to Melbourne last year, was accomplished by a small British machine, the Miles "Hawk Major," built by Phillips and Powis (Reading) Ltd. This machine is not a specially-designed racer, but a standard light aeroplane using an engine of only 130 h.p. and selling at £750. A "Hawk Major" flown by Sq. Ldr. Malcolm MacGregor and Mr. H. C. Walker finished fifth in the handicap race, however, completing the journey in 118 hrs. 5 min. 46 sec. flying time, and 5 days 15 hrs. 13 min. total time. Its performance was easily the best made by any light aeroplane in the race, for although a D.H. "Puss Moth" piloted by Mr. C. J. Melrose, of Australia, was third, this machine does not quite come within the category of light aeroplanes. In any case the "Hawk Major" took only about two hours longer for the journey.

By its flight the "Hawk Major" set up a new record for light aeroplanes for the journey from England to Australia, reducing the previous record by about 30 per cent., and also made a light aeroplane record for the flight to India, which occupied 2 days 4 hrs. 58 min. If these flights had been accomplished a fortnight before the race they would have been universally acclaimed, but as all ideas of speed and distance were shattered by the amazing flight of the D.H. "Comet" piloted by Messrs. C. W. A. Scott and T. Campbell-Black, the feats of the smaller machine were almost unnoticed.

Another great success was achieved by Miles aeroplanes in last year's race for the King's Cup, when Mr. Thomas Rose piloting a Miles "Hawk" fitted with a D.H. "Gipsy III"' engine developing 118 h.p., recorded the highest speed in the race, averaging 147.78 m.p.h. in the final. He secured second place in the race, although he started off scratch in the final. It is interesting to note that Mr. Rose won another heat at a speed of 147.75 m.p.h. and that Mrs. G. Patterson in a standard "Cirrus"-engined Miles "Hawk," won a heat at a speed of 117 m.p.h., figures that are all the more praiseworthy because of the extremely bad weather conditions in which the race was flown.

These successful machines were designed by Mr. F. G. Miles, who is well-known as the designer of several interesting aeroplanes. Two of his early products were the Southern "Martlet" and the Miles "Satyr," which were both single-seater biplanes noteworthy for their high performance and their suitability for aerobatics, and as sports types for the private owner. The "Martlet" was built by Southern Aircraft Ltd., and was 25 ft. in span and 20 ft. 3 in. in length. When fitted with a D.H. "Gipsy III" engine, it had a maximum speed of 130 m.p.h. and a cruising speed of 95 m.p.h., and when it was produced, in 1930, was one of the fastest British light aeroplanes. The "Satyr" was not built until 1932. As in the case of the "Martlet" the machine was of wooden construction except for a small amount of steel tubing in the wings. Its performance was very similar to that of the "Martlet."

Although both these machines were successful, during recent years Mr. Miles has devoted his attention to low wing cantilever monoplanes. The first machine of this type that he designed was the Miles "Hawk," a two-seater light touring or training monoplane. Phillips and Powis Aircraft (Reading) Ltd. entered the aeroplane manufacturing field by producing this machine, and an interesting feature is that they were at first able to market

the aeroplane at a very low price because they secured a big number of "Cirrus III" engines from a Canadian company that went into liquidation.

The "Hawk" is an all-wood machine, and is noteworthy for its clean outlines, as are all machines designed by Mr. Miles. Tapered wings are employed in it, although they had previously been thought too expensive to construct for a low-priced private machine. A special feature is that the petrol tanks are arranged so that they can be withdrawn from the centre section without difficulty when the wings are folded back.

A "Hawk Major" in flight, showing its exceptionally "clean" and pleasing lines.

The fuselage of the machine is of normal rectangular construction, with a domed roof, and is 24 ft. in overall length, while the wings are 33 ft. in span. The undercarriage is of the divided type and makes use of low pressure tyres. In the early models no attempt was made to streamline the undercarriage, but streamlined "trousers" are now provided. The two occupants of the machine are accommodated in tandem open cockpits containing complete dual controls, and a large luggage locker is provided aft of the rear cockpit.

In spite of the fact that the first "Hawk" only employed a 90 h.p. "Cirrus III" engine, it was capable of attaining a maximum speed of 115 m.p.h. and of cruising at 100 m.p.h.

The "Hawk" achieved such remarkable success and popularity that a modified and greatly improved machine, known as the "Hawk Major," was designed. This is a very "clean" low wing monoplane embodying the latest features of design such as tapered wings, a "trousered" undercarriage and wheel brakes. It is of all-wood construction and is of the open type, having two cockpits in tandem. The wings, which are of the ordinary cantilever type, are 33 ft. 9 in. in span when folded and the fuselage is a plywood-covered wooden frame 24 ft. in length. The undercarriage is divided, each wheel being supported on a single leg, and the leg and the wheel are covered with a special cowling so that only a small part of the tyre is exposed to the airstream.

The standard "Hawk Major" is provided with a D.H. "Gipsy Major" engine developing 130 h.p., which gives it a maximum speed of 150 m.p.h. It is capable of carrying a load of 700 lb. and when fully loaded is 1,800 lb., or more than three-quarters of a ton, in weight.

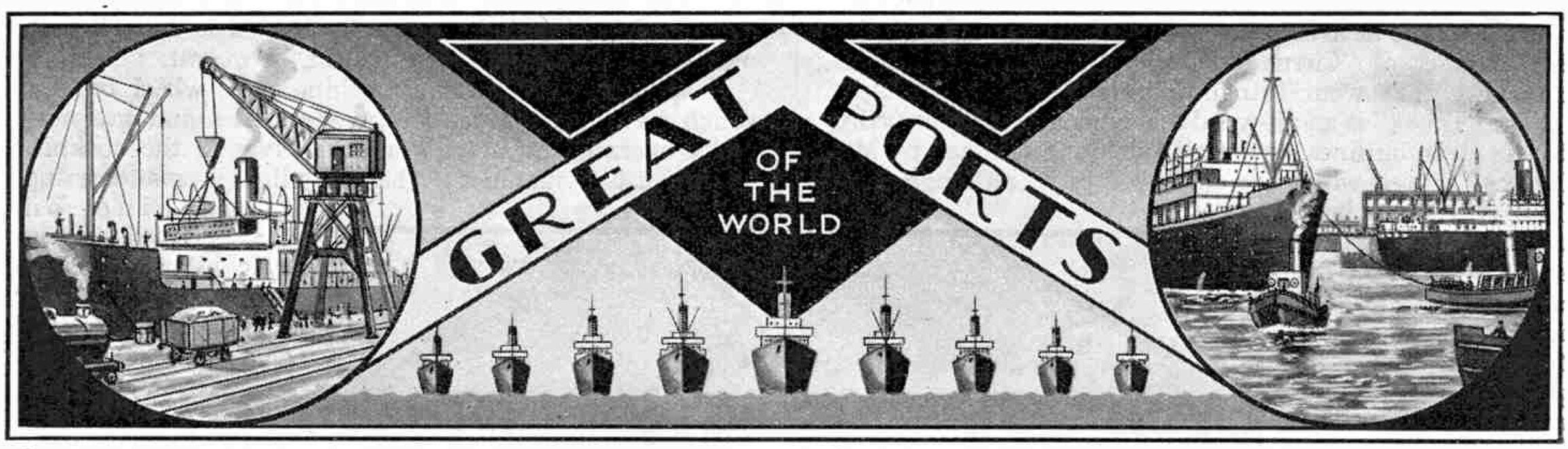
A special feature of the machine is its wheel brakes, which have been invented by Mr. Miles and are normally operated by moving a hand lever in the cockpit, in the usual manner. When a pilot is manœuvring a machine on the ground, however, he often wishes to use the brakes on each wheel independently of each other to assist in steering. The special Miles brakes are therefore arranged so that their controls can be coupled up with the rudder bar, and any movement of this then causes the brakes to be applied more severely on one wheel than on the other. This practice does not interfere with the normal use of the bar.

The "Hawk Major" is unique in that although it is one of the cheapest high-speed light aeroplanes available in this country, in its construction many operations are carried out that previously were thought possible only in making the most expensive aeroplanes. For instance, tapering makes it necessary for all the ribs in each wing to be of different lengths. The wings on all Miles aircraft, however, are interchangeable and thus mass production methods can be employed in the manufacture of the ribs.

An interesting method of assembling the wing structure is followed. The ribs are placed on special jigs and plywood that has been treated to make it stretch is covered with glue and nailed over the ribs. By the time that the glue has set and the wood has dried, it has shrunk considerably and is quite taut, making it unnecessary for any covering of fabric to be employed. When this stage is reached the nails are extracted and the holes stopped up. This method of construction is particularly durable.

Mr. Miles' latest product, the "Falcon" four-seater cabin machine. This type combines high performance with great economy both in initial cost and operating expense.

Mr. Miles has now produced an improvement of the "Hawk Major," known as the "Falcon." This is practically identical in construction with the "Hawk Major," but is a little larger, being 35 ft. in span and 25 ft. in length. It has accommodation for four and is of the cabin type. Either a 130 h.p. "Gipsy Major," or a 200 h.p. "Gipsy Six" engine can be employed in the machine. The "Gipsy Major" gives it a maximum speed of 148 m.p.h. and a cruising speed of 130 m.p.h., (*Continued on page 94*)



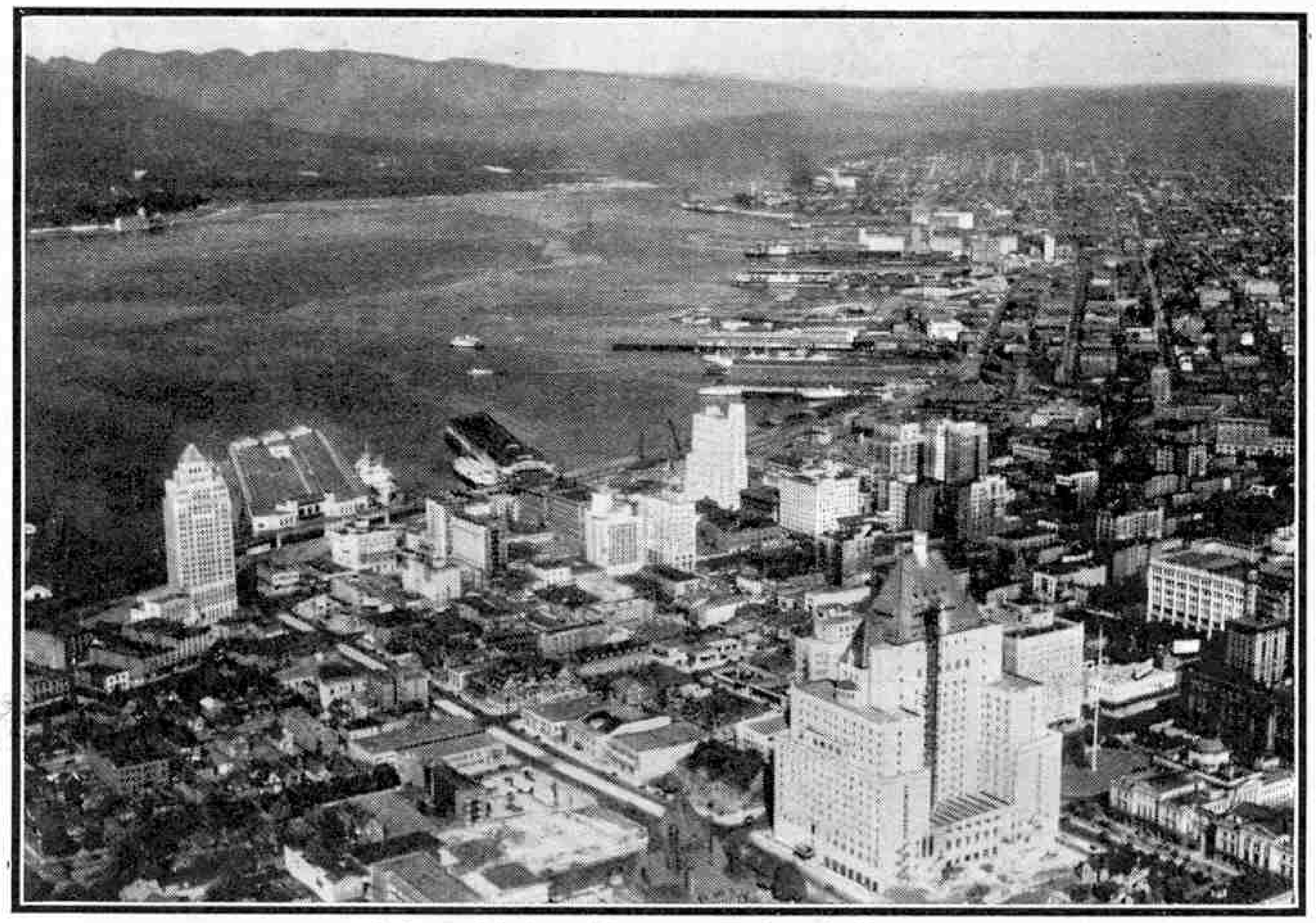
XIII.—VANCOUVER

LESS than 70 years ago practically all the land on which Vancouver stands was virgin forest roamed by deer, bear, puma and coastal Indian tribes. The growth of the city has been so rapid that the story of its rise to become one of the leading seaports of the world is a romance in itself. Capt. George Vancouver, the English navigator after whom the city is named, could never, even in his wildest dreams, have pictured the busy thriving metropolis that has sprung up on the site he discovered.

In 1791 Capt. Vancouver was given command of an expedition to the northwest coast of North America, one object of which was to discover an eastward passage to the Great Lakes of Canada. He surveyed the coast of California and British Columbia, and also that of the large island nearly 300 miles long and almost 80 miles wide, now named after him, that is separated from the mainland of British Columbia by the Strait of Georgia. He entered this Strait, and after sailing past Siwash Rock with its lone tree, a monument carved by nature and famous in Indian legend and song, he discovered a long natural harbour sheltered on the north side by timber-clad, snow-capped mountains, while to the south were the sloping wooded shores now occupied by Vancouver. He named this harbour Burrard Inlet, after Sir Harry Burrard of the British Navy, and a nautical survey of it was made in 1860 by Capt. George Richards of H.M.S. "*Plumper*."

The first white settler on the site of Vancouver spent his first night there with an Indian, in the autumn of 1862. He was John Morton, a young Englishman who, with two others, bought 550 acres of land where is now the west end of the city. Morton's small log cabin and barn were the first buildings to be erected on that shore. Later a Capt. Stamp arrived, and he built a mill called The Hastings Sawmill, and around this there grew up the village of Granville.

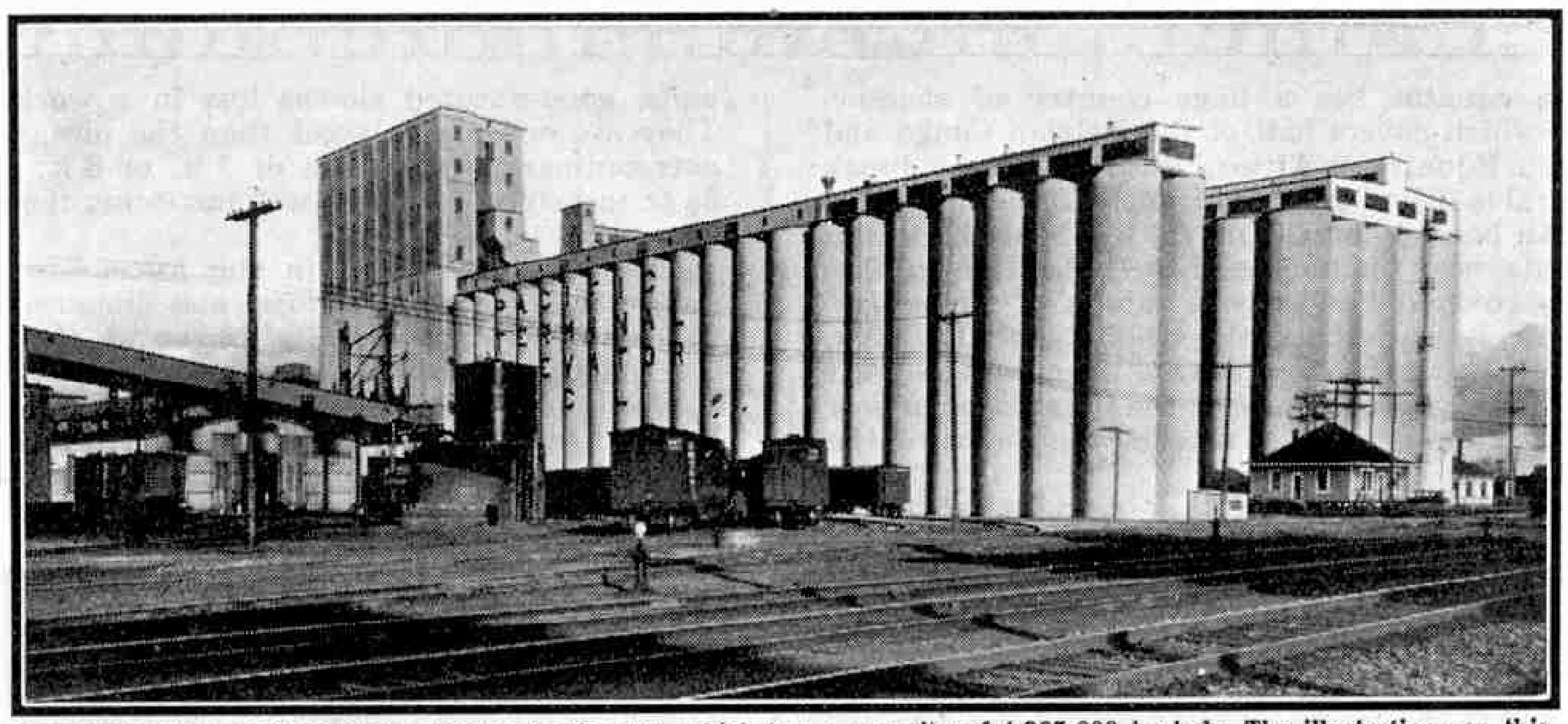
By 1884 Granville had become a small town. In that year Mr. W. C. Van Horne, later Sir William Van Horne, Vice-President and General Manager of the Canadian Pacific Railway, entered into negotiations with the Premier of British Columbia to acquire lands for railway terminal purposes at Coal Harbour and English Bay. Granville also was inspected, and Van Horne was delighted with its situation as compared with Port Moody, the original objective of the railway. It was decided that the line should be extended to Granville, and Van Horne's proposal to change the name of the town to Vancouver was endorsed by the proper authorities.



A fine aerial view of Vancouver Harbour, looking east.

Vancouver had already become established as a port, chiefly by exporting lumber. This trade had begun to develop about 1865, and had increased so rapidly that in 1876 no less than 50 ships laden with lumber sailed from the port. Timber was also extensively used locally, for it was the common building material. This circumstance contributed to a terrible disaster in June 1886, when a fire that broke out in Vancouver spread rapidly among the wooden buildings and ultimately destroyed the city. At that time the population totalled about 2,000. When rescue and salvage work had been carried out the big task of rebuilding the city was begun, and

many of the timber structures were replaced by more solid buildings of brick and stone. A new and better Vancouver rose from the ruins of the old one, and since that time such wonderful progress has been made that Vancouver is now the fourth largest city in Canada. Spacious thoroughfares, fine public buildings and tall skyscrapers have been built, while port developments have included the construction of huge piers, docks and grain elevators.



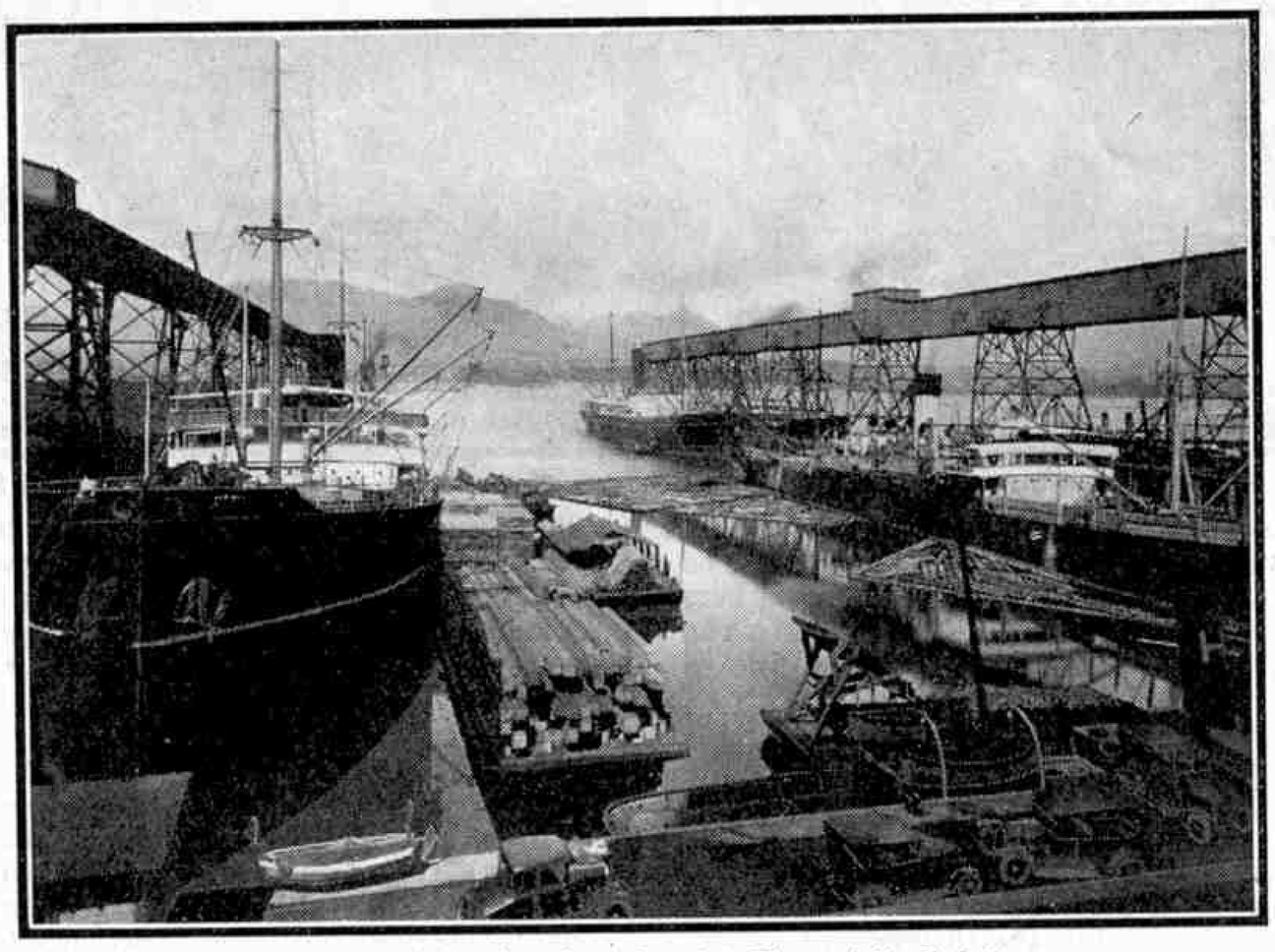
Vancouver Harbour Commissioners' No. 1 Elevator, which has a capacity of 4,335,000 bushels. The illustrations on this page are reproduced by courtesy of Leonard Frank, Vancouver, B.C.

Vancouver is situated on a peninsula that juts out into Burrard Inlet. This Inlet, or Harbour as it is usually called, varies in width from one quarter of a mile at its entrance to two-and-one-quarter miles in the main harbour. On the north shore is the City of North Vancouver, which is connected with Vancouver proper by a bridge accommodating rail and other traffic at a point called the Second Narrows, and by harbour ferries that also serve the adjacent municipality of West Vancouver.

The harbour is one of the largest and most beautiful in the world, with an area of 48.78 square miles and 98 miles of shore line. The entrance is known as the "Lion's Gate" from the fact that twin mountain peaks closely resembling crouching lions overlook the harbour and the city. The harbour is practically land-locked and is undisturbed by wind from any direction. It is open to navigation all the year, and is entered from the sea through a channel of sufficient depth and width to permit the largest vessels afloat to enter. It is divided into three parts, the outer harbour lying west of the First Narrows, the central portion extending from the First to the Second Narrows, and the part east of the Second Narrows. Most of the shipping is concentrated in the central part, which has about 10 miles of waterfront and a maximum width between north and south shores of 2¼ miles. Along the waterfront on both shores of this part are piers, docks, grain elevators, lumber mills, meat packing plants, oil refineries, canneries and bulk oil storage plants. East of the Second Narrows the harbour extends for a distance of nine miles to Port Moody, and in this section are also lumber mills, oil refineries and fuel oil storage plants. The piers and wharves on Vancouver's waterfront are of the most modern construction.

The principal piers and wharves include the Commissioners' Ballantyne and Lapointe piers; the Canadian Pacific and Canadian National piers, and the Nos. 1 and 3 grain jetties. At the Ballantyne Pier there is 2,610 ft. of quay where ships can berth, and the depth of water alongside at low water is 45 ft. at the outer berths and 32 ft. at the inner berths. The Lapointe pier provides 2,500 ft. of berthing and the depth alongside is 35 ft. at low water. The four Canadian Pacific piers have a total of 7,749 ft. of quay available for ships, and the Canadian National pier provides 2,374 ft. of berthing. The two grain jetties have a total quayage of 2,400 ft. Numerous other piers and wharves are allocated to various private companies.

There is ample warehouse accommodation at the port, and spacious one-storey or two-storey sheds are provided on all the piers and wharves. Ballantyne Pier, for instance, has four two-storey sheds covering a total area of 410,040 sq. ft., and having a total storage capacity of 41,040 tons.



Loading lumber and grain at Lapointe Pier and No. 1 Jetty.

The Terminal Railway owned and operated by the Commissioners links up the numerous piers, wharves and dock sidings, and connects directly with the main lines of the two great Canadian railway systems, the Canadian National and the Canadian Pacific railways. It acts as a delivery line for all Canadian National traffic to and from Vancouver, and also serves exclusively the industries of the north shore. The port is also served by the Pacific Great Eastern Railway to points in the interior of the province; by the Great Northern Railway of the United States, and by the British Columbia Electric Railway Company Limited to local points and to the Fraser Valley. The Terminal Railway has 22 miles of track, and it operates over an additional 12 miles of track by agreement with the other railway companies mentioned.

The Port of Vancouver is known as Canada's "Gateway of the Pacific," as most of the country's rapidly increasing exports and imports to and from the Orient, India, Australia and New Zealand, (Continued on page 94)

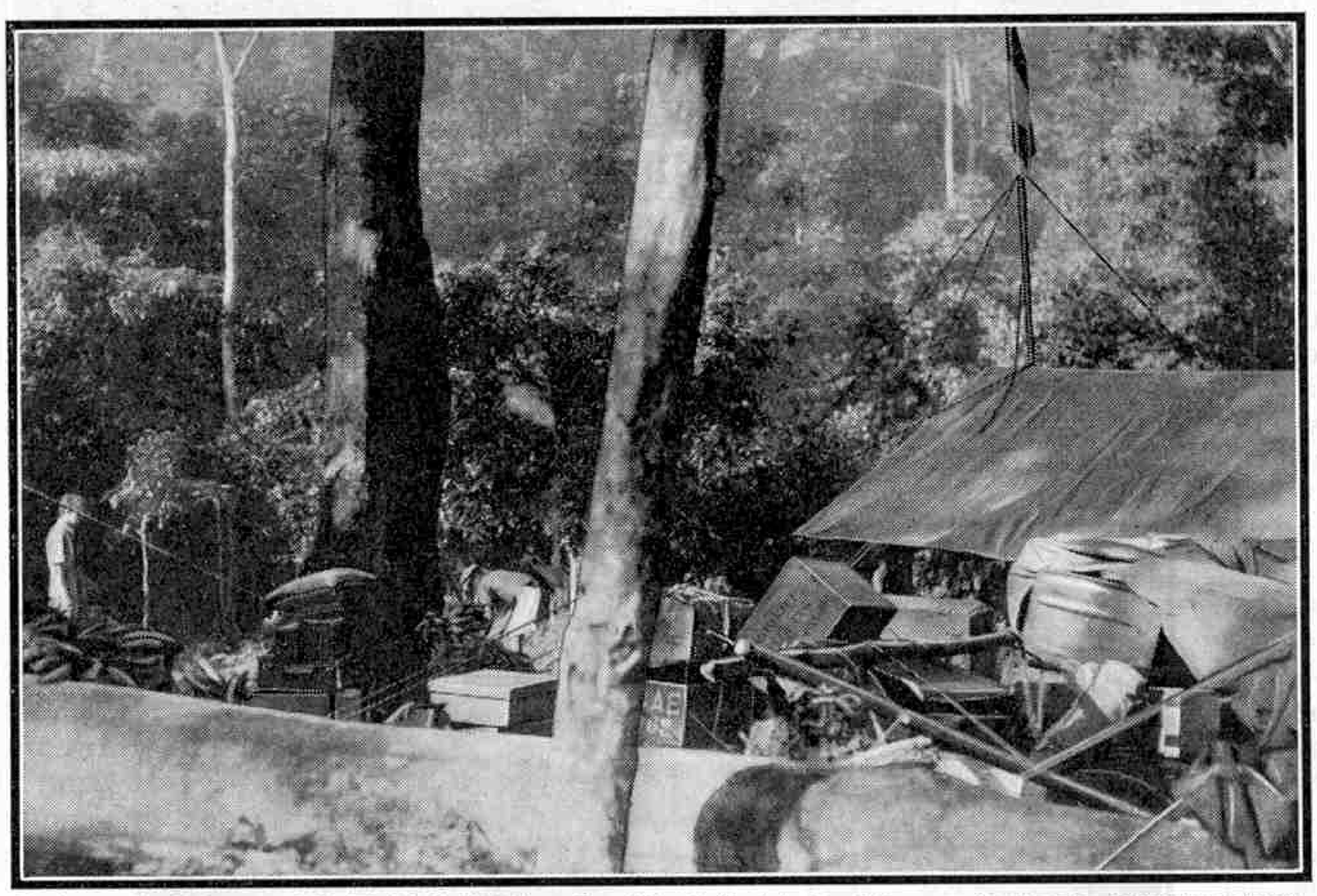
Famous Explorer Writes for the "M.M."

I.—Attilio Gatti Describes the Equatorial Forest

STRADDLING the equator lies a huge country of shadow, fear and mystery, which covers half of the Belgian Congo and a good part of French Equatorial Africa. With scarcely a break this almost impenetrable belt stretches from the Ubangi-Uole, that is from the Sudan borders, on the north, to about the fourth degree of south latitude, near the middle of the Lake Tanganyika. After having entirely covered hundreds of ranges of mountains, and enclosed in a dark, heavy setting the sapphires of the Kivu, Edward and Albert lakes, it spreads westward, framing the great Kassai and Congo rivers, invades a part of the Cameroons and of Gabon, and is defeated only when it reaches the shore of the Atlantic.

This is the primeval equatorial forest, a paradoxical world completely shut within itself, which seems to have been crystallised in its immutability for hundreds of centuries. At a few miles' distance from civilised centres with very modern little towns, sometimes one of the infinite tentacles of the forest reaches out, and before it everything stops —human activity, progress, civilisation.

Every now and then some white man, particularly stubborn, has ventured into this alien world. For days and weeks he has cut his way, step by step, through an infernal entanglement that seems interwoven with every possible tree, bush, creeper and nettle on earth. But his strength has very soon become exhausted, and he has been compelled to retreat or forfeit his life—as many others have done before him—without having scratched more than the edges of this immense region, the greater part of which is known to no one, black or white.



Setting up the first camp of the Eighth Gatti African Expedition in the interior of the unexplored region of the Ituri Forest.

From the moment one reaches the edges of the forest one finds the first striking contrast in the natives who live there. These, the Watussi, are giants 7 ft. to 7½ ft. in height, picturesque and intelligent, who came, no one knows when or why, or from what point, to constitute in Ruanda an island of ancient Egyptian civilisation. Others, the Bandando, are at the opposite end of the scale. Wretched in body, dirty, stupid, filled with ignorant superstitions, they are passive victims of cruel secret societies, dominated and directed in all probability by a few chiefs and witch doctors of other and higher races. And, as soon as one enters the first mile or so of the undisturbed forest, the only human beings he can find here and there are some diminutive caricatures of men 4 ft. high—the pygmies. Their simian expressions and habits, their prehensile feet, their uncanny way of climbing trees and slipping between the thick vegetation, make them seem more monkeys than men.

In contrast, the apes one encounters in that strange world look more like prehistoric men than monkeys. They are the giant gorillas, the least known, the largest, the rarest and most ferocious of the four anthropoids, completing their astonishing similarity to man in structure and organ by the embarrassing fact of having no tail. Pachyderms awake the echoes of the mountainous forest, but they are only half the size of the normal elephant, and lively, agile, good-natured clowns lost in a world of drama and fear. They are not much larger than the pigs, which there reach the extraordinary proportions of 7 ft. or 8 ft. in length and 5 ft. or 5½ ft. in height, monsters well justifying their name of giant forest hog.

The buffaloes, which in the forest are innumerable, do not escape this distortion of form and dimension. Much smaller than the variety that is usually known as the African buffalo, they lack its massive horns with the solid bulging base and the long curved points. Their weapons are two small straight horns, no larger than those of a young cow of Europe, but beware of them. For if the buffalo of the plains and of the swamps has the name of being vicious, cunning and vindictive, his red-haired brother of the forest, so muscular and agile and quick in his movements, is ten times more dangerous.

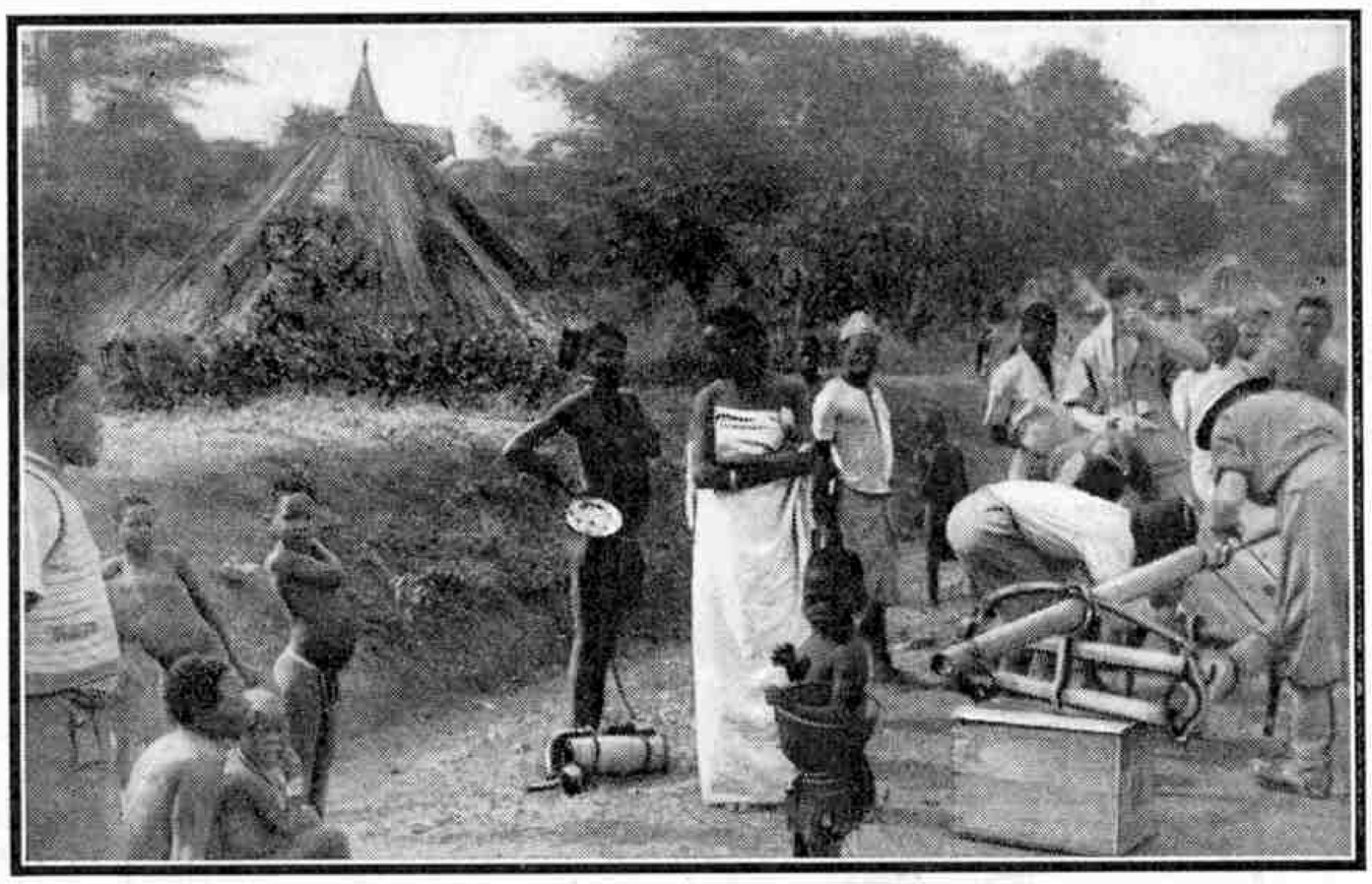
One of the most beautiful antelopes, the bongo, hides itself in the dense belt of trees and rank vegetation that surrounds the foot of mountains so high that the sun of the equator fights a losing battle to melt the snow on their peaks. The bongo, too, is a curiosity, if not in form, at least in its customs, or the customs the pygmies attribute to it. For the pygmies firmly believe that this antelope feeds on charred remains of burnt trees, and that during the night, scorning to lie in the mud and damp grass, it hangs by its horns from a tree! This, naturally, is not literally true, but it undoubtedly springs from the bongo's inordinate dislike of getting wet, for only during the rainy season does he emerge from the thickness of the forest, in order to avoid as much as possible the continual dripping of water from the leaves. The bongo has another peculiarity. The males are all misogynists, for they keep themselves in separate groups far away from the females, except at the season of mating, when they share their company for a short period.

Even the giraffes, already freaks of nature, have produced a striking representative of their family to give to the equatorial forest—the okwapi. But the okwapi, although one of the family, has preserved only the head, his body being that of a common antelope, and his legs seemingly copied from the zebra's; while his skull resembles nothing less than a prehistoric animal, the Samotherium of the Lower Pliocene of Europe. A super-freak, therefore, and a suitable one with which to close this brief enumeration of the strangest inhabitants of the equatorial forest known at present.

It was to observe the unspoilt pygmies of this equatorial forest; to learn the customs of the aristocratic Watussi; to study the mysteries of the secret societies of the Bandando, and to collect their weapons, instruments and ornaments for the Witwatersrand University of Johannesburg; to obtain for the Tring Museum specimens of as many rare animals as possible; to surprise and photograph the okwapi in his natural environment and to capture two young of this beautiful animal for the London Zoological Society, that the Eighth Gatti African Expedition spent long months of study and preparatory work. This was work complex and

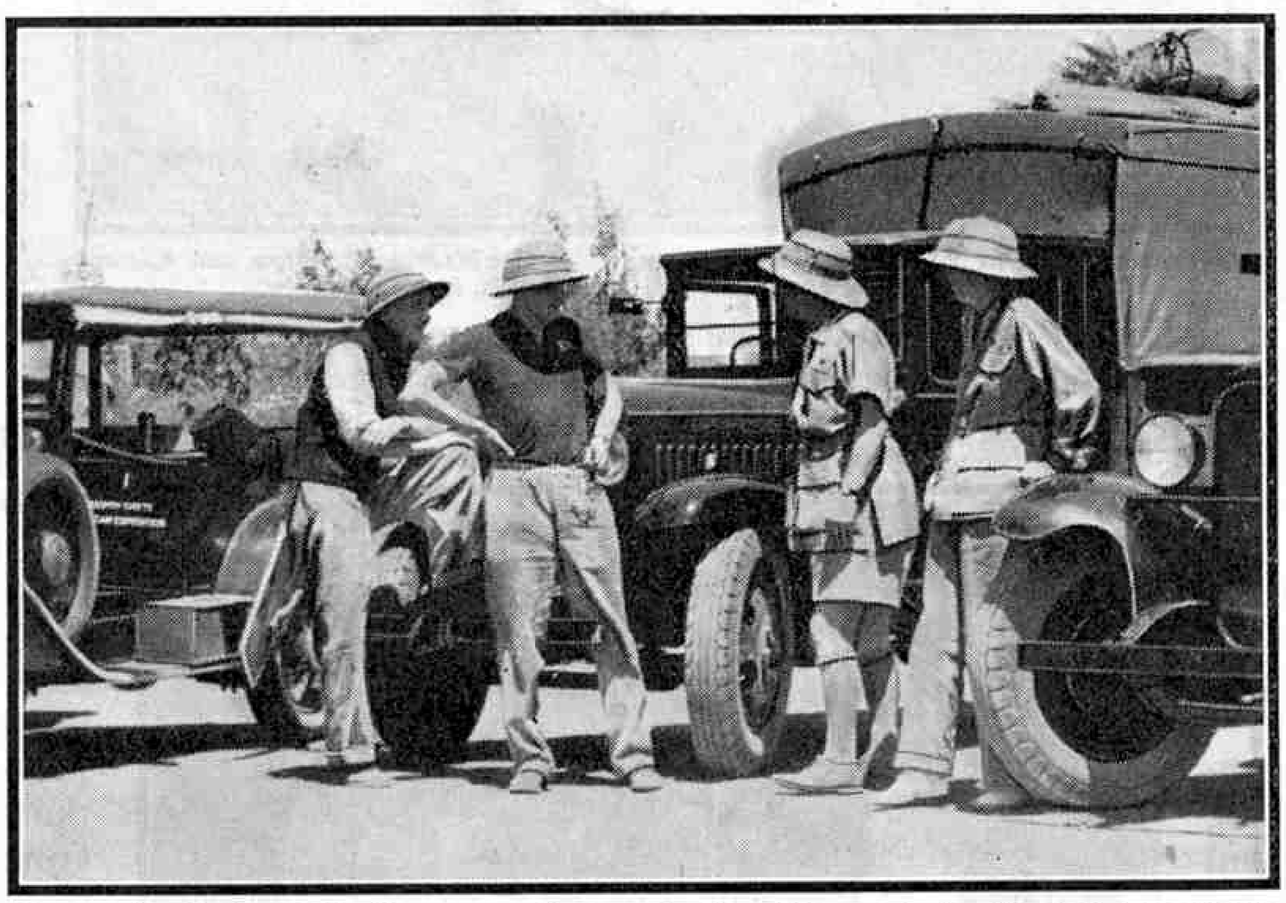
difficult in proportion to the purposes the expedition wanted to accomplish, particularly so because of the country in which it was easy to foresee we would have to live for the greater part of the time.

It is enough to glance at a good map of Central Africa to realise this. As long as our itinerary took us through Kenya and Uganda from our Mombasa landing port to Belgian Congo, via Nairobi, Kampala, Masako, everything would be simple. There were good roads and sound bridges, towns and villages, garages and filling stations, hotels and stores where in case of necessity everything could be found. But on entering Ruanda, a country occupied but a very short time, things begin to change. The frontier post is appropriately called Kakitumba Bridge, as the bridge over the small border stream is the outstanding feature, the remainder being represented only by the house and office of the one official stationed there. The roads are good, but one must cover hundreds and hundreds of miles before finding a post with a few whites, all officials, and some poor stores, all run by Indians. Both posts and stores grow rarer as through the region of the great volcanoes and the Parc National Albert one approaches the "unexplored country," as the maps still term all the territory west of the Boni-Irumu road to the Ituri and Ibina rivers. And rightly, for not only does no white know it, but not even the natives or the pygmies, who are themselves strangers in the neighbourhood, having been removed from their former pestiferous homes near the Lake Edward and the Semliki River by the Belgian authorities, and concentrated in new, clean villages along the road.



The strenuous efforts to get the long caravan started for the forest.

"Unexplored country," "Very dense forest," "Uninhabited," is written on the map here and there across huge spaces completely white and bordered by tiny green signs, very thickly drawn, to indicate the edges of the forest already known. "Inaccessible country covered with very dense forest" is marked across another big space tentatively covered with the same green signs. Finally, between the parallels 0°30′ and 1° north of the equator and the 29°20′ and 29°40′ longitude, there are 1,000 odd square miles that the cartographer did not know how to describe any better than with "Limit of forest unknown," and again "Dense forest." There it was easy for me to imagine that the okwapis, very numerous in the whole region, must be even more so, and perhaps less wild and shy than in other points where they had already been disturbed, although only very occasionally. And there I had decided to go in spite of every difficulty, to carry on all the part of our work that had to be done in the interior of the forest.



Commander Gatti and his three companions on the Expedition ready for the start from Kenya on 2nd February, 1934.

But of course to live and work there for several months with my three companions, in the comfort that the climate of the forest makes indispensable, meant that an enormous quantity of material must be prepared, for once there it is impossible to obtain any new supplies, the nearest post being at a hundred kilometres, and the nearest town at a thousand. Every case and bale, more than 200 in all, had to be specially packed to protect its contents from the appalling humidity of the forest, and of a weight and size to enable it to be carried on the heads of porters through the infinite network of interwoven vegetation through which we should have to cut our way each day until we came to a favourable spot to establish a base camp.

As if the progression of obstacles provided by the country itself were not enough, our work became increasingly difficult the further we ventured. It is only by chance, it seems to me, that the giant Watussi have escaped until now the knowledge of the big public, and from the short contact I had had with them during my previous expedition I knew that with some patience and savoir faire I should be able to learn from these intelligent and kindly men all I desired to know. Less easy was the subject of the Bandando and the pure pygmies of the Ituri. Although I knew that I could count, as ever, upon the greatest help from the Belgian authorities, my past experience in Africa had taught me to fear the passive resistance, tainted with ignorance and imbecility, that the native knows how to oppose to everyone who wants to investigate affairs that tradition, and even more the fear of revenge and vendettas, make him regard as tabu. As for the pygmies, their spirit of supreme independence, their ceaseless wanderings, and the simplicity of their minds, make of every inquiry, however trivial, a matter of infinite time and patience and labour.

But the rare animals, and particularly the okwapi, were from the outset the great problem. Although they are far more numerous than is generally believed, to approach near enough to observe their habits, to photograph, and, worst of all, to capture them alive, seemed to me at times an utter impossibility. For one thing, the senses of hearing and of smell of all the animals of the forest are hypersensitive. Their sight is extremely keen, and their agility, their resistance, and the manner in which they can slip silently and quickly through even the thickest vegetation are really marvellous. By contrast, the white man in the forest is simply hopeless. If he doesn't pick each step with the utmost caution and the most extravagant contortions, his boots slide in the thick mud, crunch dead sticks, and stumble against stones and fallen trees. His garments and his helmet brush against leaves and branches and attach themselves to thorns and ragged stumps, with the result that the noise he is forced to make, augmented by the extraordinary acoustics of the forest, is enough to scare away any animal within a mile.

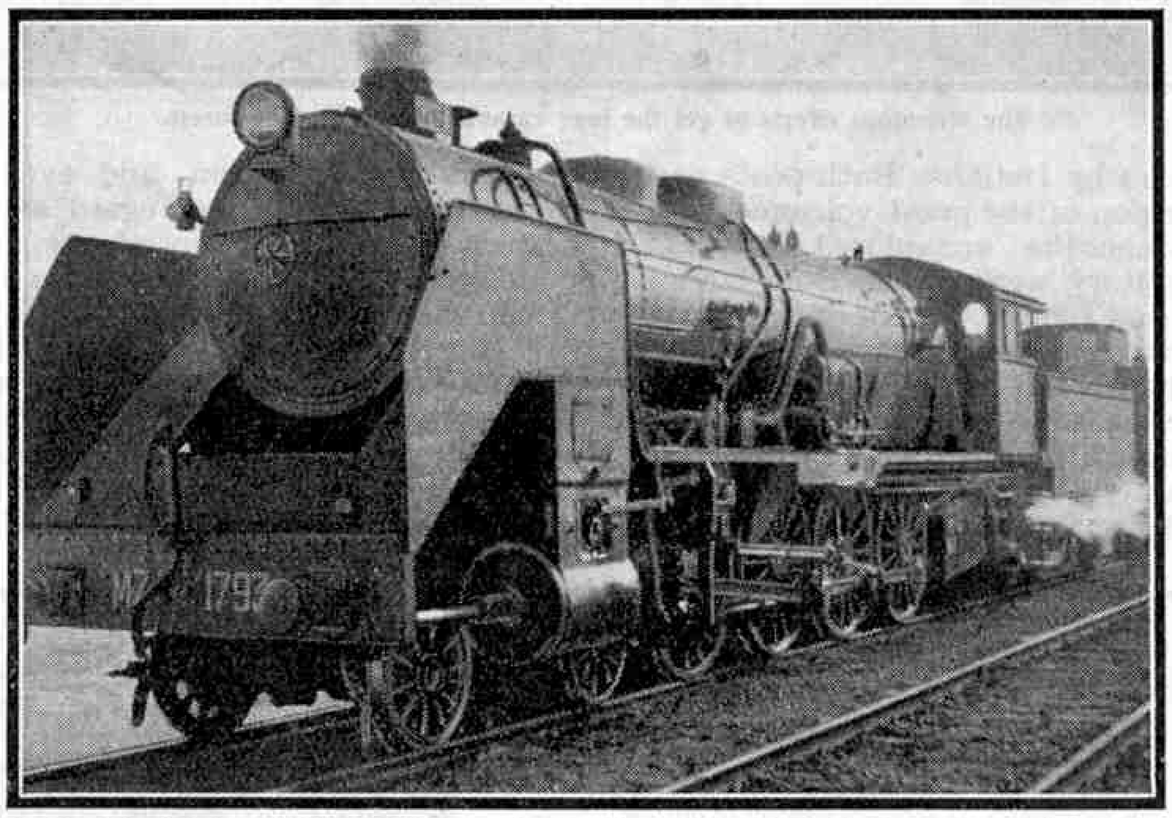
The march is terribly slow, both because of the oppression of the hot and humid atmosphere and of the thousand impassable entanglements that continually compel long detours. In addition there are all the barriers of difficulties put up by natives and pygmies, without whom it is useless even to try to proceed. Here, they refuse to go on account of malignant spirits; there, because of an extraordinary animal that kills at sight. Still, with great patience, little by little destroying some superstition, exposing the baselessness of some fear, every day trying to select the best and most serious natives and to instruct them and form them for the work, one reaches the point where he can get what he wants done.

(To be continued)

These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles that are published will be paid for at our usual rates. Statements contained in articles submitted for these pages are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

An Interesting Spanish Locomotive

I think readers of the "*M.M.*" will be interested in a description of the Spanish express passenger locomotive seen in the photograph on this page. It is one of the most recent "1700" series employed on the Madrid, Zaragoza and Alicante Railway, and is of the 4–8–2 or "Mountain" type now employed on practically all Spanish express trains to and from Madrid. Altogether there are 100 of these locomotives. They were built in Barcelona and one of them was a feature of the International Exhibition held in that city in 1929.



A Spanish 4-8-2 or "Mountain" type locomotive of the Madrid, Zaragoza and Alicante Railway. Photograph by J. Villá Pagés, Barcelona.

As the photograph shows, the engines are impressive in appearance. They are built to a gauge of six Castilian feet, or 5 ft. 6 in., which is the standard in Spain. Walschaerts gear is employed, and the engines are equipped with Dabeg feed-water heaters, similar to those tried on certain British locomotives of the L.N.E.R. and L.M.S.R. The latest engines of the class have smoke deflectors to prevent interference with the driver's range of vision.

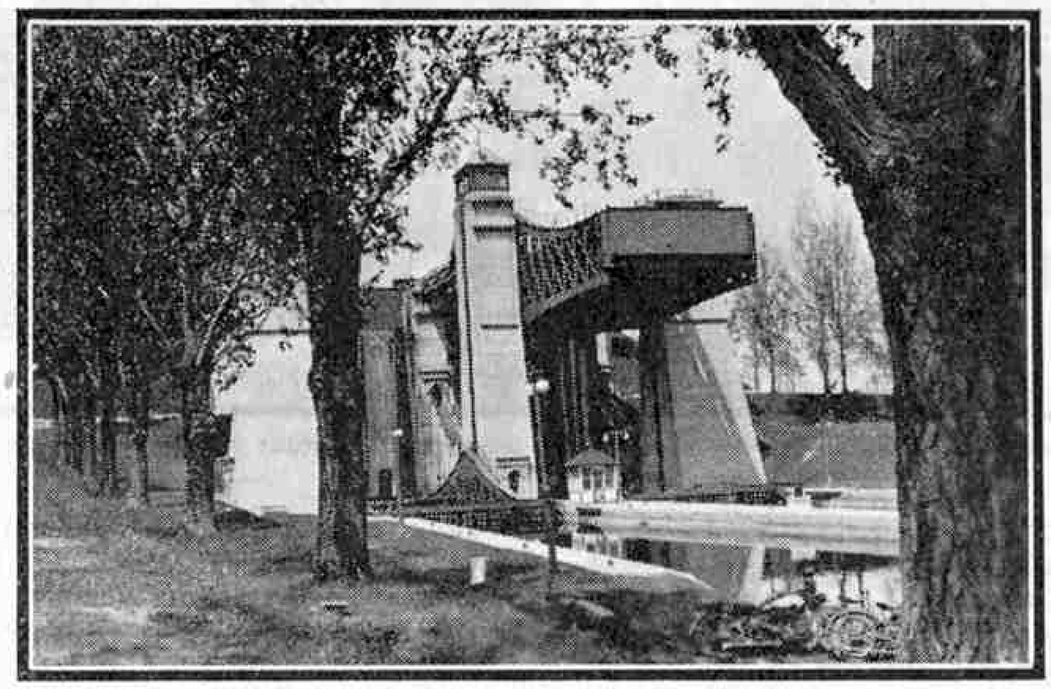
The weight of the locomotive and tender in working order is 156 tons 6 cwt. and the adhesion weight is 63 tons. The driving wheels are 5 ft. 2 in. in diameter, and the cylinders have a diameter and stroke of 2 ft. and 2 ft. 4 in. respectively. The steam pressure is 199 lb. per sq. in. This figure seems unusual, but is simply the equivalent in English units of 14 kg. per sq. cm., the figure in metric units used by the designers and makers of the locomotive. Speeds of 68 m.p.h. can be attained with ease.

J. Villá Pagés (Barcelona).

A Great Canadian Lift Lock

I was greatly interested in the article on the electric canal lift at Niederfinow, Germany, that appeared in the issue of the "*M.M.*" for last December, because I live near what is claimed to be the largest hydraulic canal lift lock in the world. This is at Peterborough, Ontario, and is a striking object to those who travel along one of the roads leading out of the town, for they see it suddenly as they reach the top of a hill and look down into the valley below them. The road actually cuts through the concrete superstructure of the lock, and in this there are openings through which its working can be watched.

There are two troughs, or chambers, to accommodate boats using the lift. They are made of steel plates and each is 140 ft. long, 33 ft. wide and 9 ft. 10 in. deep. A boat coming up the canal to be raised to the higher level enters the trough awaiting it and the gates that shut off the water are closed by hydraulic power. A giant steel ram under the trough is then raised by hydraulic pressure, and as the boat is pushed upward the descending trough passes it. At the top of the lift of 65 ft. the gates are again opened, but this time those at the opposite end of the trough are operated in order to allow the boat to pass through to the higher level canal, and to proceed on its way. The actual lift only occupies one and a half minutes.



The world's largest hydraulic lift lock. This is at Peterborough, Canada. Photograph by J. A. Cash, Belleville, Ontario.

The lock is one of Peterborough's show places, and is a prominent object, for its towers rise to a height of 100 ft. above the ground.

J. A. Cash (Belleville).

A Tea Planter's Day

The monotonous beating of tomtoms awakened me only 10 minutes before the time for the early morning muster of coolies. I dressed rapidly and hurried to the muster ground, to find about 300 natives waiting for their orders for the day. Each section took up its allotted position on the ground, the women pluckers standing in one place, the men pruners in another, and the manure forkers forming still another group. In a few minutes they were counted and their names entered in the muster book, and all were sent off for their tools.

After breakfast I called for my horse and started my eight-mile round of work. I had 50 coolies lopping shade trees and spreading and forking inorganic manure in a newly-pruned field. I inspected their work and told the "Kangang," or Tamil foreman, the acreage to be covered during the day. I then rode on to the pruners. These coolies are the highest paid men on a tea estate, and their work is interesting to watch because of the dexterity and agility with which they use their sharp curved knives.

Weighing leaf, picked on a tea plantation in Ceylon, before despatching it by overhead ropeway to the factory. Photograph by W. T. Baker, Haputale, Ceylon.

At length I reached the plucking field and weighed the leaf gathered during the morning. Boys then placed sacks containing 45 lb. of leaf on their heads and ran with them to the overhead ropeway on which the produce is carried over mountains and ravines to the factory three miles away.

My division is one of the steepest in the island, and as I continued my round I had to ride up a narrow winding path, with a sheer drop of several hundred feet on one side and a steep slope on which tea was planted on the other. I was looking at the tea, for it had only just been plucked and should have been broken back to a level, when suddenly I realised I was right on the outer edge of the path. The next instant my horse began to slip. Somehow I managed to get my feet out of the stirrups and fell inward, to grasp the edge of the path and haul myself to safety as the kicking animal slipped from under me and fell to the bottom of the ravine.

It was with a heavy heart that I put down each coolie's name in my check roll in the evening, for the place where my horse usually waited seemed terribly empty.

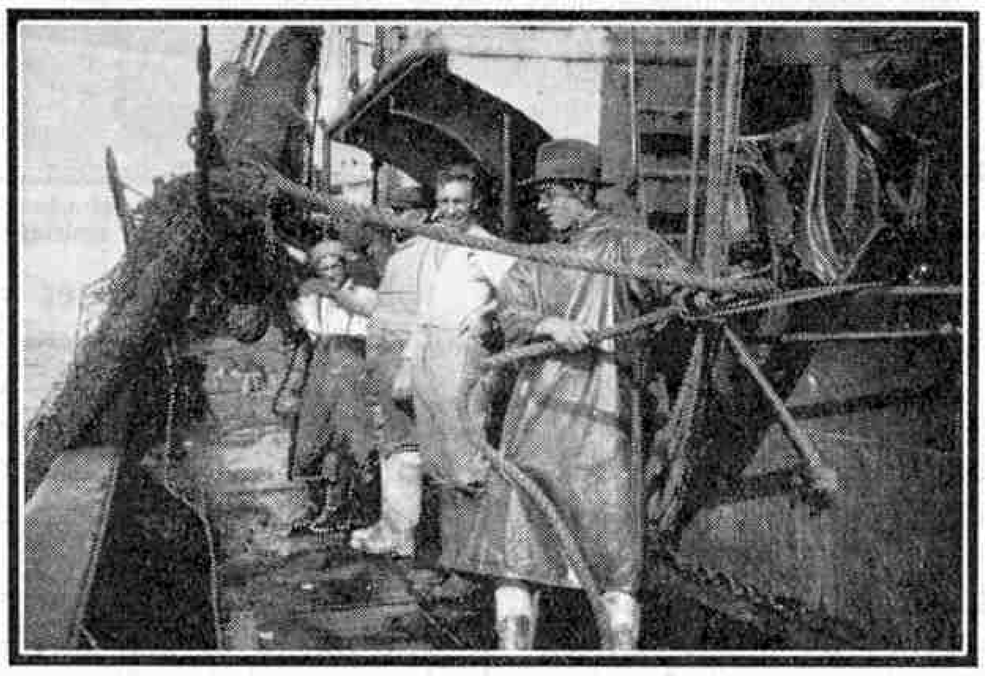
W. T. Baker (Haputale, Ceylon).

Deep Sea Trawling

From the bridge of a Grimsby trawler I watched the scene on the floodlit deck at hauling time. It was only four o'clock, and the skipper had swung the boat round in order to get the trawl on the port side, and two steam winches had pulled up the net by means of wire hawsers. A phosphorescent glow on the surrounding water indicated a good catch, and the skipper was singing a hymn, which also foretold a good haul. The men had now reached the apex or narrow end of the trawl. A rope with two eyes, called a becket, was slipped round its mouth and attached to a pulley wire, and the bag of fish was swung on board. The third hand had the slimy task of going underneath it to untie the knot, and when he did so out fell the curious mass of jumping plaice, turbot and sole.

The net was carefully examined for holes and again swung over the side. The engines were restarted and the brakes released, allowing the wire hawsers to be paid out, and the trawl again was hauled slowly through the sea.

The men now stood on the slippery mass on deck, gutting the fish at high speed and pitching each into its correct basket. Finally the catch was washed with a hose and packed away in the ice chamber forward. There were five baskets of plaice, nearly two baskets of sole, and two large turbot. No wonder the skipper sang. I went to sleep on the floor of the chart room, hoping that I should not be awakened by the noise of the winches when the nine o'clock haul came.



Hauling in the trawl on a Grimsby trawler during a North Sea cruise. Photograph by N. W. Jenkins, Stone.

There are nine men in the trawler in which I made my interesting voyage. The skipper is in sole charge. He has no salary, but receives a percentage of the profits, and is the only person on board who knows where we are, and where we are going. He is also the one who decides when to return to port. The mate shares in the profits, and his task is to take half the watches on the bridge and to go on deck during hauls. The third hand shares the watches with the mate, and the two deck hands take the wheel in turn between the hauls. The trimmer is the junior member of the crew and does all the dirty work between hauls, such as trimming the coal, and getting cinders from the boiler room and throwing them overboard.

The two engineers seem to have the best time, although they have to stoke for themselves and keep up steam for their triple expansion engines of 250 h.p. The speed of the vessel is reduced from 12 knots to 2 knots when trawling, and an interesting point is that the skipper rings down to the engine room 10 minutes before each haul so that steam pressure can be reduced in order to save blowing off when the engines are stopped. Lastly there is the cook, a very good man to be friendly with!

N. W. Jenkins (Stone, Staffs.).

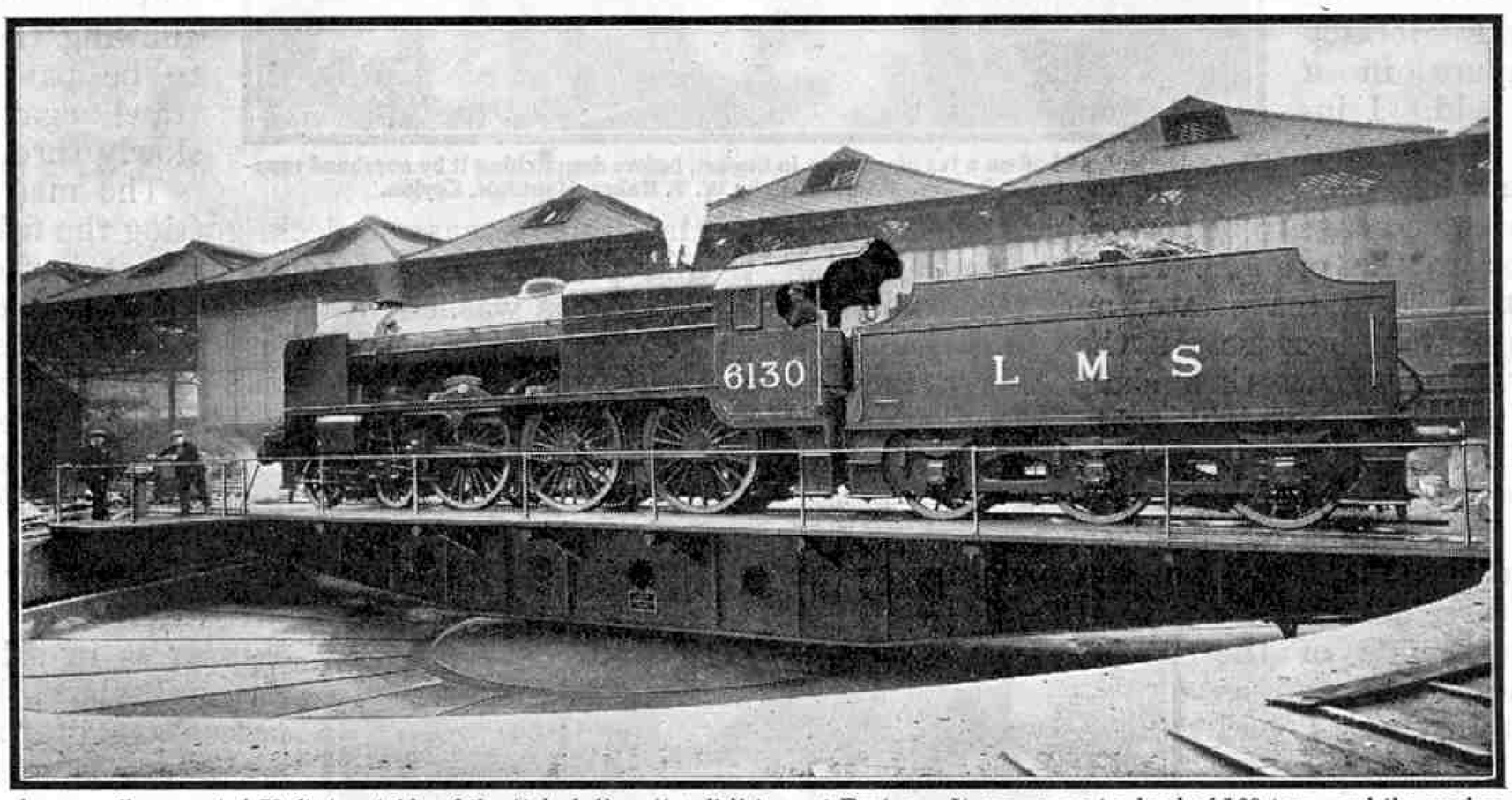
Locomotive Turntables

Some Interesting Points in their Design

By F. M. Bowen

THE turntable has become an indispensable unit in railway working, and one at least is provided at all termini and other important stations, because tender locomotives practically always work with the engine leading. Turntables were described in the "*M.M.*" for March, 1933, but in this article it is proposed to deal in more detail with the actual methods of construction and testing used in their manufacture.

The best possible materials and workmanship are essential in turntable construction in order to ensure complete reliability, for any breakdowns would have serious consequences. For example, in the type of locomotive shed known as a "round-house" a turntable is indispensable, as it forms the centre from which the shed tracks radiate. This unit as a whole, therefore, must be entirely dependable.



A manually operated 70-ft. turntable of the "deck" or "well" type at Euston. It can support a load of 160 tons, and the engine and tender shown on it can be turned by one man in 1¾ minutes. Photograph by courtesy of the L.M.S.R.

The manufacture of turntables forms a branch of its own in constructional engineering, and in Great Britain and Germany particularly their construction has been continually developed and improved.

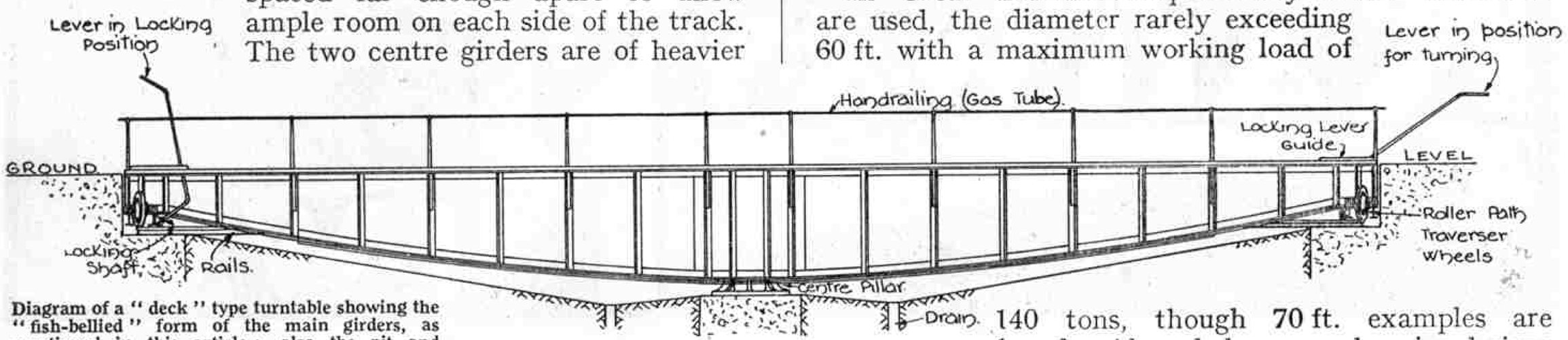
The centre-bearing type of turntable greatly outnumbers any other at the present day, and this may be sub-divided into the "deck" or "well" type, and the "through" type. In general, the turntable consists of two main girders connected together by cross girders and bracing and pivoted on a centre bearing that takes the total weight of the table and its load. Whereas in the "through" type the locomotive rests between the main girders, in the "deck" type it stands directly over them. Consequently the latter needs a much deeper pit or well than the former, but this is counterbalanced by the fact that in the through type several heavy cross girders are required to transmit the load to the main girders, so that the total steelwork weighs considerably more than in the deck type turntable of the same diameter and gauge. This excess weight is usually about one-fifth more than the weight for the deck type.

When a turntable design is called for, a standard loading system, provided by the railway company's engineer, is used to calculate the amount of material required in each part. The whole of the main frame is made from mild steel plates and sections riveted together. Half of each main girder acts as a cantilever and must be designed as such. These girders are almost invariably "hog-backed" for a through type and "fish-bellied" for a deck type; that is, the overall depth is reduced from centre to ends in such a way that the moment of resistance of the girder section is proportional to the bending moment throughout the entire length of the structure of the turntable.

The girders are of the simple web type with flanges formed of mild steel angles and plates, and each end rests upon two rolled steel joists known as the end carriages. On these carriages are mounted bearings carrying the cast iron roller-path traverser wheels, which are provided with ball race centres, and run upon a circular track built in the pit. The main use of the traverser wheels is to prevent the turntable from tilting when an engine runs on or off. The centre bearing is always designed to withstand the total combined weight of locomotive and turntable.

Though some turntables are electrically equipped, the majority are turned by hand, by means of levers or by a crank handle and winding arrangement. One lever at each end may be employed both for turning and for operating the locking gear. The construction of the latter is quite simple. Each turning lever is cranked at the lower end, and bored to fit a steel shaft carried by cast iron brackets mounted on the end carriages. On the shaft are small tapered locking levers that run in slots cut in two cast iron blocks, and these blocks are made to slide into castings fitted on to the sides of the pit. By lifting the turning lever the shaft is made to rotate, causing the locking levers to push the blocks into the locking castings, thus fixing the turntable in such a position that the rails are all in line, and the locomotive may safely run on or off. Conversely, by lowering the lever the turntable is free and may be rotated.

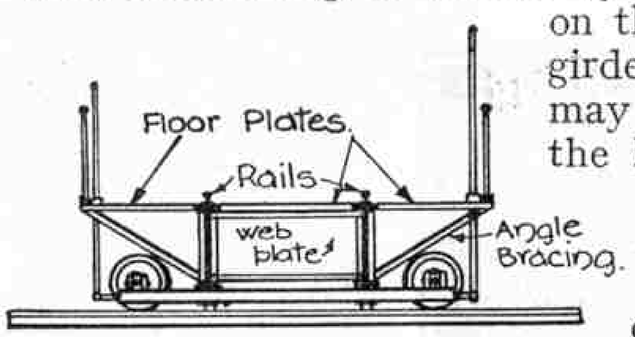
Here close resemblance between the through and the deck type turntable ends. In the former the track is carried upon railbearers and cross girders, the main girders being spaced far enough apart to allow ample room on each side of the track. The two centre girders are of heavier



— ELEVATION. —

Diagram of a " deck " type turntable showing the " fish-bellied " form of the main girders, as mentioned in this article ; also the pit and general arrangement of details.

section than the others, and are connected together by a built-up centre stretcher, fastened by suspension bolts to a cast steel upper bearing cap. In the deck type the cross girders are dispensed with, and the centre stretcher is fastened directly to the main girders on which the rails rest. A platform of mild steel chequered plate, or wooden planks, usually provided with handrailing, is carried by cranked angles fastened on the outside of each main girder, and some of these may be lengthened to form the handrail standards. In both types the whole weight is suspended from the upper bearing cap by the massive suspension bolts connected to the centre stretcher diaphragms.



— PART END VIEW. —

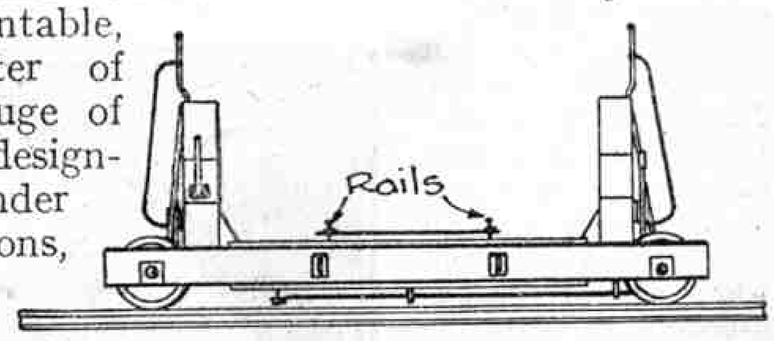
" Deck " type turntable showing main girders and bracing.

The centre bearing—the " heart " of a turntable—may be any one of three types—pin and cup, ball race, or conical roller. In the first of these a mild steel case-hardened semi-spherical pin, fitted into the upper bearing cap, rotates in a phosphor bronze cup fastened to the lower bearing cap. This type has been superseded in later years by the other two types, which reduce friction and provide easier and smoother turning. In the second type the load is carried by a specially-designed ball race placed between the upper and lower bearing caps, and the upper cap is shaped to fit a mild steel cup, thus forming the rocking pintle. The third type is similar, except that conical rollers, tapering towards the centre, are used in place of the ball race.

A through type turntable is usually employed on marshy or similar ground, as in the large pit required for a deck type considerable trouble would be experienced from water leakage. The deck type is generally adopted in other cases, for the initial cost, taking everything into consideration, is lower ; and for the turntable alone the price is considerably less than for a through type, owing to the lighter steelwork.

The actual figures of course depend upon the design of the turntable, the price of the materials, and the existing working conditions.

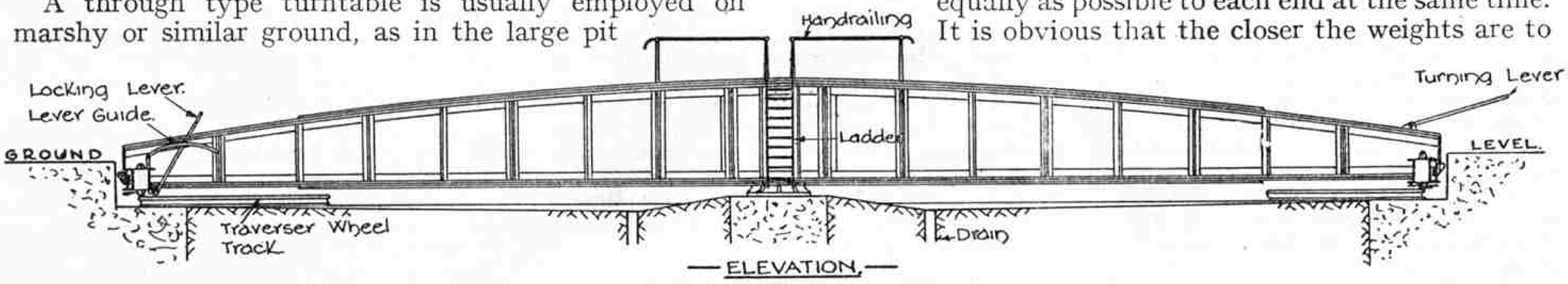
In Great Britain comparatively small turntables are used, the diameter rarely exceeding 60 ft. with a maximum working load of 140 tons, though 70 ft. examples are found. Abroad, however, heavier designs are necessary to cope with the larger stock, and diameters vary from 50 ft. to 100 ft., with working loads of from 120 to 280 tons. Many turntables have been constructed in Great Britain for shipment abroad, especially to the Colonies and South America, those required by the Indian Railways in particular being exceptionally massive. One of the heaviest turntables ever made in Great Britain was shipped to India in 1929 for the Madras and Southern Mahratta Railway. This deck type turntable, with a diameter of 85 ft., for a gauge of 5 ft. 6 in., was designed to work under a load of 270 tons, and was tested to 320 tons. Including the weight of the table itself, 68 tons, the total load on the centre bearing when under test was 388 tons, and the deflection in each main girder was $\frac{5}{8}$ in. In the same year a deck type turntable 100 ft. in diameter was constructed for the Kenya and Uganda Railway. Owing to the narrow gauge, one metre, a special design was necessary. This turntable, for 200-ton locomotives, weighed 80 tons in all, and required a pit over 10 ft. deep at the centre.



— PART END VIEW. —

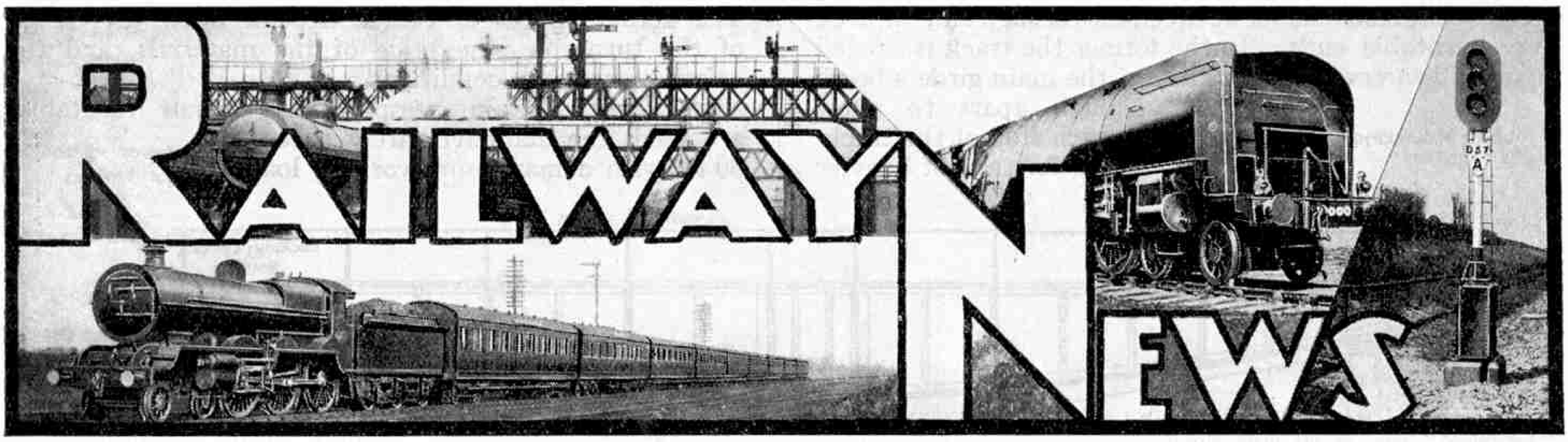
" Through " type turntable showing the heavy main and cross girders.

Every turntable is erected, tested and inspected at the makers' works before being released. The test load specified is about 25 per cent. more than the working load, and usually consists of a number of blocks each weighing 10 tons. In placing these on the turntable the loading is commenced at the centre, and continued as equally as possible to each end at the same time. It is obvious that the closer the weights are to the ends of the girders the greater will be their effect on the deflection, and this method of loading prevents undue distortion. When the total test load is on the turntable, this is rotated a number of times in each direction, and then unloaded, weights being taken off from the ends first ; that is, the order of loading is *(Continued on page 132)*



— ELEVATION. —

A " through " type turntable showing the " hog-backed " girders. This diagram enables a direct comparison to be made with the " deck " turntable at the top of this page.

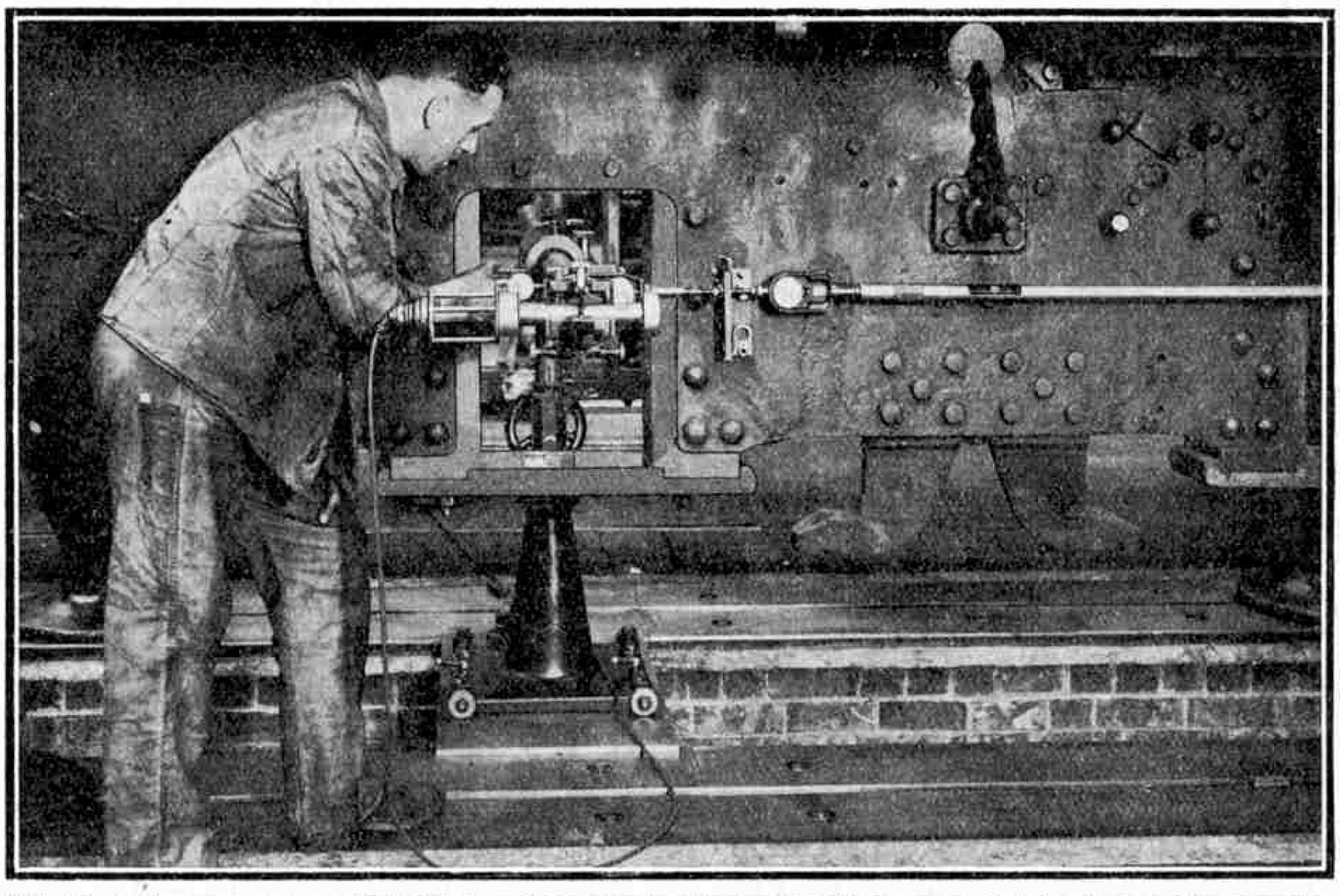


Conversion of S.R. "Baltic" Tank Engines

As announced in the *"M.M."* for July last, the seven 4–6–4 "Baltic" express tank engines of the former L.B. and S.C.R. are being rebuilt with separate tenders to make them of more general utility when, owing to the forthcoming electrification, they will no longer be required for working the London–Eastbourne services. The conversions are being carried out to the designs of Mr. R. E. L. Maunsell, chief mechanical engineer, at Eastleigh works, and the first to be completed is No. 2329, *"Stephenson."* In its new form this engine has a handsome appearance, and was greatly admired when placed for exhibition at Waterloo Station on Tuesday, 8th January.

The principal alterations comprise the removal of the trailing bogie, coal bunker and water tanks, the shortening of the main frames, and the provision of a new cab with side windows that, together with the fitting of a shorter chimney, brings the reconstructed engines within the loading gauge of the Southern Railway and permits of their use on any of the main lines other than the Tonbridge to Hastings section. In their rebuilt form the engines have the boiler pressure raised to 180 lb. per sq. in., and are provided with standard 5,000 gallon double-bogie tenders, bringing them closely into line with the existing 4–6–0 "King Arthur" class locomotives. Other alterations include the substitution of vacuum for Westinghouse brake, and pop safety valves for those of the Ramsbottom type. The driving wheels are 6 ft. 9 in. in diameter and the cylinders measure 22 in. by 28 in.

The rebuilt engines will be known as the "Remembrance" class and will have names as follows: No. 2327, *"Trevithick"*; No. 2328, *"Hackworth"*; No. 2329, *"Stephenson"*; No. 2330, *"Cudworth"*; No. 2331, *"Beattie"*; No. 2332, *"Stroudley"*; and No. 2333, *"Remembrance."* The last-mentioned locomotive, which gives its name to the class, is well known as the War Memorial engine of the L.B. and S.C.R.



This illustration shows the optical lining-up apparatus described on Page 95 in use at Swindon Works. The operator is adjusting part of the apparatus between the horn cheeks that accommodate the axle boxes. This illustration is reproduced by courtesy of the Editor of the "Great Western Railway Magazine."

New L.N.E.R. Express Services in Scotland

Commencing on 1st January some valuable additions were made to the L.N.E.R. express services in Scotland. In the northerly direction a restaurant car train leaves Edinburgh (Waverley) at 7.25 p.m. for Aberdeen, calling at Dundee, Arbroath and Montrose, and reaching the Granite City at 10.43 p.m.

This train provides a very useful connection for passengers travelling from the South by the 11.20 a.m. *"Queen of Scots"* Pullman train from King's Cross which hitherto has not had a connecting service beyond Dundee.

In the reverse direction a new train leaves Aberdeen at 8.55 a.m., calls at Montrose, Dundee and Kirkcaldy, and arrives at Edinburgh (Waverley) at 12.4 p.m., this being the fastest timing in operation between Edinburgh and Aberdeen since the War.

Speeding Up L.N.E.R. Goods Trains

Certain of the important night freight trains on the L.N.E.R. have been speeded up in pursuance of the Company's policy of providing over-night services for goods traffic. Specially constructed wagons fitted with continuous brakes are used and the total amount of time saved nightly on this group of trains is no less than 13 hrs. 50 min.

G.W.R. to Build More "Castles"

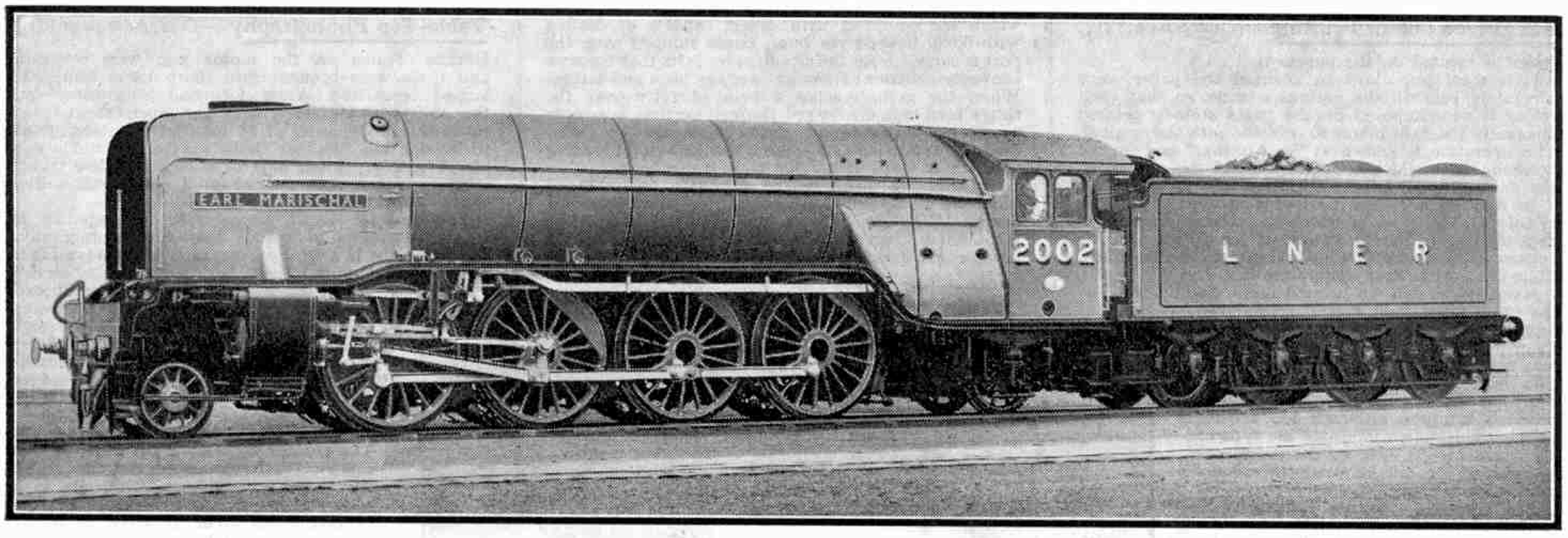
During last year 106 engines were built at Swindon works. They comprised the following: 10 express locomotives of the 4–6–0 "Castle" class; 10 goods engines of the 0–6–0 2251 class; 10 tank engines of the 2–6–2 "51" class; 50 tank engines of the 0–6–0 "57" class; 10 tank engines of the 0–6–0 "64" class; six 0–6–0 tank engines of the 1366 class; and 10 tank engines of the 0–4–2 "48" class. The locomotives of the "64" and "48" classes are fitted for auto-train working. In addition 20 tank engines of the 2–8–0 classification were converted into 2–8–2s of the "72" class.

There are now 380 engines of the 0–6–0T type "57" class, and, as a result of the introduction of this standard shunting engine the number of old single- and double-framed tank engines of various classes has been considerably reduced.

Work is now proceeding on the new batch of 4–6–0 locomotives of the "Hall" class, and the frames of some of these were laid down during January. Further engines of the "Castle" class, 10 in number, are to be put in hand afterwards to be ready for the traffic of the coming summer. Other engines to be built at Swindon this year are 10 standard goods engines and 60 tanks.

The G.W.R. programme for 1935 also provides for the construction of 211 passenger vehicles and 2,486 freight wagons of various types. About 390 miles of track will be renewed and 130 bridges will be rebuilt during the year.

Among the many engines that have been condemned recently are three 4–6–0s of the "Star" class. They are: No. 4005, *"Polar Star"*; No. 4010, *"Western Star"*; and No. 4029, *"Spanish Monarch."* Of these No 4005, *"Polar Star,"* was notable as being the G.W.R. engine concerned in the "locomotive exchange" of 1910 between the L.N.W.R. and G.W.R., working chiefly between Euston and Crewe. In exchange, the L.N.W.R. 4–6–0 "Experiment" engine *"Worcestershire"* ran on the G.W.R.



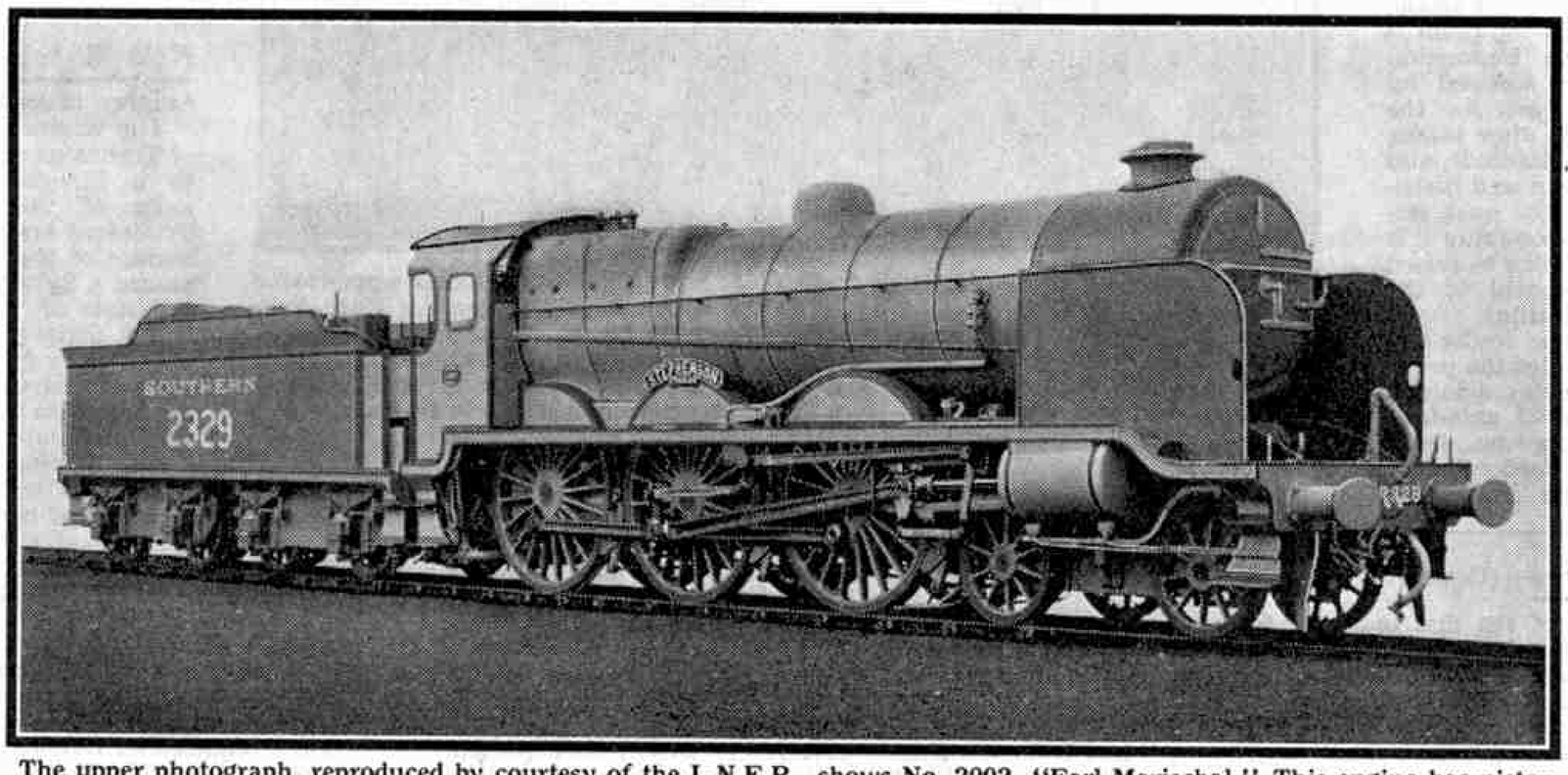
L.N.E.R. Giant Locomotive in France

The L.N.E.R. giant locomotive *"Cock o' the North"* has been put through a series of very thorough tests on the special locomotive testing plant at Vitry, near Paris, and some striking results are confidently anticipated, although at the time of going to press no details had been made public.

The *"Cock o' the North"* arrived at Calais on 6th December last, together with its train of three 40-ton wagons of coal, a covered wagon containing fittings, and a brake van. After the Customs authorities had duly inspected the engine and the other vehicles, the engine proceeded to the Locomotive Shed of the Nord Railway at Calais where steam was got up for the journey to Paris. This journey commenced at 7.36 a.m. on December 7th and, hauling its train behind it, *"Cock o' the North"* set off for Paris travelling via Boulogne, Abbeville, Amiens and Le Bourget, where it was transferred to the Paris Grande Ceinture Railway and finally on to the Paris-Orleans Railway to complete its journey to Vitry. The brightly painted green engine with its train of wagons, bearing the words "London and North Eastern Railway," everywhere attracted considerable attention.

On Saturday afternoon, 8th December, the engine was put on to the test plant at Vitry to enable the necessary adjustments to be made and the various instruments to be connected up and the tests proper began on Wednesday, 12th December.

The testing plant at Vitry is designed to deal with locomotives weighing up to 29½ tons per axle, capable of a tractive effort of approximately 100,000 lb. and at speeds up to 100 m.p.h. The tests are carried out under laboratory conditions, the locomotive being placed on a series of wheels or rollers that absorb the power output from the wheels of the locomotive and constitute the means by which the requisite measurements are obtained. The locomotive is secured at the rear end to a drawbar through which the pull exerted by the engine at varying speeds is measured.



The upper photograph, reproduced by courtesy of the L.N.E.R., shows No. 2002, "Earl Marischal." This engine has piston valves and Walschaerts motion instead of the poppet valves and gear of "Cock o' the North." In the lower illustration appears S.R. No. 2329, "Stephenson," formerly one of the "Baltic" tanks employed on the Brighton section, now converted to a 4-6-0 tender engine. Photograph by courtesy of the S.R.

L.M.S.R. Locomotive News

New express locomotives of the standard 4–6–0 three-cylinder "5X" class turned out from the works at Crewe are numbered 5633 to 5654, and complete the series that was on order there. Further engines of this class have also been received from contractors, and the order for 50 of the 4–6–0 mixed-traffic engines, class "5," has now been completed by the Vulcan Foundry Limited.

From the Company's works at Derby additional 2–6–4 passenger tank engines have been sent out up to No. 2536, and 10 of the 4–6–0 three-cylinder "5X" class engines, Nos. 5655 to 5664, are now in hand there.

The 4–6–2 engine No. 6201, *"Princess Elizabeth,"* has been fitted with a double chimney for experimental purposes.

The L.M.S.R. have ordered 10 Diesel-electric shunting locomotives from Sir W. G. Armstrong Whitworth & Co. Ltd., Newcastle, and 10 from the English Electric Co. Ltd.

The full L.M.S.R. locomotive renewal programme for 1935 numbers 287 engines. Of these 10 will be 4–6–2s, and 30 are to be of the "5X" Class 4–6–0s, and 155 will be mixed traffic 4–6–0s.

Included among the engines condemned recently are the following 4–6–0 "Claughtons": Nos. 5915, *"Rupert Guinness"*; 5921, *"Sir Arthur Lawley"*; 5930, *"G. R. Jebb"*; 5937; 5950; 5961; 5967, *"L/Corpl. J. A. Christie, V.C."*; 5989; 6001; 6003 and 6007. Five more L. and Y.R. 4–6–0s also have been withdrawn. These are Nos. 10405, 10413, 10421, 10441 and 10447.

Since the L.M.S.R. came into being the number of different types of locomotives has been reduced from 393 to 188, while the number of locomotives superheated has been increased by 2,120, or nearly trebled.

Southern Electric to Sevenoaks

The newly electrified S.R. lines to Sevenoaks were brought into full use on Sunday, 6th January. These latest extensions are from St. Mary Cray and Orpington, and have added 23 more route miles to the Southern electric system, at a cost of over £500,000. The stations affected are Orpington, Chelsfield, Knockholt, Dunton Green, Sevenoaks (Tub's Hill), St. Mary Cray, Swanley Junction, Eynsford, Shoreham, Otford and Sevenoaks (Bat and Ball).

Four two-car trailer units and 11 three-car motor units have been built for use in these new electric services, which are supplementary to the existing main line steam trains. More trains now serve each station, the increases varying in extent from 90 per cent. to 170 per cent.

Making Up Time on the L.M.S.R.

Recently owing to a vacuum-pipe breakage, the 8.30 a.m. express from Manchester (London Road) to Euston was delayed 25 minutes in starting from Manchester, but despite further delays by permanent way slacks and signals, amounting to eight minutes, the train arrived at Euston three minutes early. The load was 253 tons from Manchester to Stoke, and 220 tons from Stoke, the engine being three-cylinder "5X" Class No. 5518.

Silk Screen Colour Printing—(*Cont. from p. 71*)

design is printed on the paper.

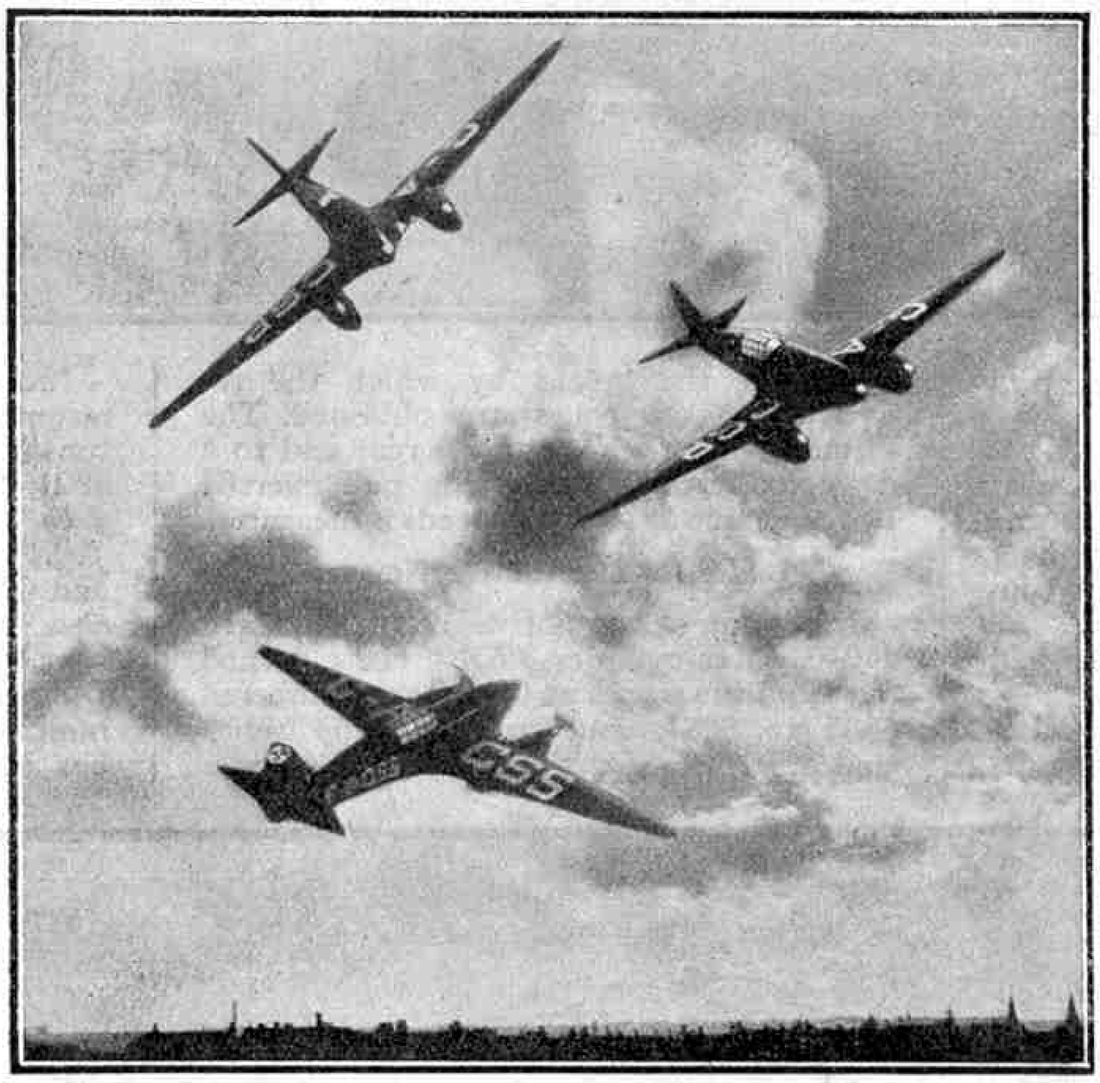
It is most important to position the paper very accurately beneath the various screens, so that each colour is superimposed on the parts already printed in exactly the right places to coincide with the original. This operation is known as "registering," and on the accuracy with which it is carried out the success of the finished work largely depends.

In printing a design incorporating a great number of colours, the order in which the colours are applied depends largely on the nature of the design and the colours themselves. Opaque colours are printed last, while the colours that occupy the largest areas of the design are printed first. In the case of the bulb poster, reproduced on page 71, the design was made up of the following colours—blue, primrose, ochre, red, light green, dark green and mauve. The original poster is a particularly beautiful example of the silk screen printer's art, and although the accompanying illustration indicates the type of work that can be done by the process, it can give no idea of the wonderful colouring that is actually present.

The series of printing operations is carried out much more quickly than the reader may think after reading this description, and providing that a sufficiently large number of prints is required, the cost of the process compares favourably with that of colour processes in which printing blocks are used.

An illustration on page 71 shows a power press machine for silk screen printing, which is marketed in this country by Selectasine Patents Ltd., London. In this machine the squeegee assembly is stationary and the silk screen and the stencil are held in a chase that is geared to an oscillating segment, and slides beneath the squeegee. The squeegee proper, however, has an up-and-down motion, and only makes contact with the stencil on its downward printing movement. Together with a paint scoop, it forms a fountain in which the paint is controlled, and after each impression the paint is automatically scooped up and lifted with the squeegee. As the stencil and screen slide back after taking an impression, the squeegee descends, and in doing so releases the scoop and distributes the paint ready for the next impression. The squeegee assembly is hinged on one side so that it can be raised to permit insertion or removal of the stencils, and to facilitate cleaning.

Any ordinary printing press feeder can quickly master the operation of the press, as the construction and feeding arrangements are similar to those of standard types of cylinder printing presses. Drying conveyors, automatic feeders and paper lifters can be fitted to the machine if necessary.



Our illustration is a composite photograph made with "Skybird" Models representing the three D.H. "Comets" that took part in the recent MacRobertson Air Race from England to Australia. The winning machine, flown by Mr. C. W. A. Scott and Mr. T. Campbell Black is shown climbing. The middle machine is that of Lieut. Cathcart Jones and Mr. Kenneth Waller, while the top one represents the machine flown by Mr. and Mrs. Mollison, who possibly were the unluckiest competitors in the race.

Lining-Up Locomotives—(*Cont. from page 95*)

matter to read by means of the dial indicator from this straightedge to each cheek of the horns.

By means of the accurate rods and the dial indicators all these measurements can easily be read to within a thousandth of an inch, although the total length between the leading and trailing horn centres may be as much as 20 feet.

Thus, a very accurate survey of the salient points of a locomotive frame can be made expeditiously; and from this, decisions can be taken as to the amount of corrections to be made.

This article is represented by courtesy of the Editor of the "*Great Western Railway Magazine.*"

Great Ports of the World—(*Cont. from page 85*)

pass through it. During 1933, ships of all classes to the number of 15,777, with a total net tonnage of 10,897,302, entered the port, and of this number 1,113 were ocean ships, and the remainder coastwise vessels. Exports amounted to 3,387,534 tons and imports totalled 2,717,311 tons.

The chief export is grain, and this branch of the trade has increased enormously during the past 14 years. The first shipment of grain in sacks was made from the port in 1909 and totalled 50,000 bushels, and the first shipment of bulk grain was made in 1921 when 500,000 bushels were exported. In 1933 no less than 68,828,024 bushels of grain passed through the port. The greatest quantity ever shipped during one day was 1,327,442 bushels, on 6th December, 1932.

The development of the grain-handling facilities at the port has done much to retain the movement of Canadian grain by Canadian railways and through Canadian ports. The total storage capacity of the elevators at Vancouver, exclusive of domestic storage, is 17,843,000 bushels, or nearly double that of the United States Pacific Coast grain elevators, as the combined capacity of the elevators at Seattle, Tacoma, Portland, Oakland and Los Angeles is only 9,945,000 bushels. No effort has been spared to ensure swift handling of the grain. It is received in the natural state, and is dried, cleaned and graded in the elevators, which are equipped with dryers capable of dealing with 6,000 bushels per hour. Grain shipped from the port is carried from the elevators by belts that traverse conveyor-galleries extending over the piers and jetties. When the grain reaches a point directly over the ship's hold it is discharged through vertical telescopic spouts to the required place. There are 19 grain-loading berths, with 93 spouts, having a total loading capacity to ships of 377,000 bushels per hour.

Considerable quantities of flour are also shipped from the port, and 1,271,127 barrels were exported during 1933. The bulk of the flour is destined for the United Kingdom, and the remainder goes chiefly to the Philippine Islands, China and Japan, the British West Indies, New Zealand and Denmark.

Vancouver is an important centre for the export of fish, and a modern dock specially designed for this traffic was put into service in May 1931. The dock is used by an average of 40 to 50 boats a day, and these moor at the dock to sell and discharge their cargoes, which are raised to the dock level by six all-metal electric cranes. The quayside equipment includes smoke-houses, ice-making plant and freezing rooms.

The port is the chief outlet for the lumber industry of British Columbia, and in 1933 lumber, logs, piles and laths totalling 213,573,796 ft. B.M. were exported. Other commodities exported in considerable quantities are paper and pulp, shingles, apples, canned salmon and pilchards, fish oil and fish meal, concentrates, doors, wool and hides, salt herring. Many thousands of tons of lead and zinc are shipped from Vancouver.

On the import side, large quantities of Australian flour, bananas from British West Indies and Central America, canned and fresh fruits, rice, iron and steel, are brought to the port. Other commodities imported are coffee, dried fruits, bulk corn, porcelain, chinaware, gunnies, crude oils, raw sugar, salt, tea, tinplate, and fresh vegetables; and there is also a huge tonnage of in-transit freight through the port. It is the chief port of entry on the Pacific Coast for Japanese oranges, and 469,466 boxes were landed during 1933.

Vancouver is also an important passenger port, and there are direct passenger services from there to the chief United States and South American ports, Alaska, Honolulu, the Orient, India, Philippine Islands, Australia and New Zealand. Countries reached by regular services operating by way of the Panama Canal include the United Kingdom, France, Belgium, Germany, Italy, Holland and Scandinavian ports. Within the harbour there are ferry services to the north and south shores of Burrard Inlet.

The Port of Vancouver is administered by the Vancouver Harbour Commission, a body created by an Act of Parliament of Canada in May 1913. The extensive powers of the Commission include the regulation of the construction of docks, quays, piers and buildings within the limits of the harbour, and of all machinery and appliances used there in loading or discharging ships.

We are indebted to the courtesy of Major J. S. Matthews, City Archivist of Vancouver, B.C., for the historical details in this article, and to the Vancouver Harbour Commissioners for the remaini g information.

Table-Top Photography—(*Cont. from page 79*)

Hornby Trains on the motor van were selected, and these were brought into sharp focus using the largest lens stop. When focussing was completed the shutter was closed and the aperture reduced to F/32. An exposure of 2½ minutes was then given with an Ilford "Eclipse Ortho" plate. The table was placed a little to one side of a large window facing south, and the time was about 3 o'clock on a dull winter afternoon.

The realistic aerial photograph on page 79 is another example of indoor table-top photography. The aeroplane is a Dinky Toy Imperial Airways Liner (Dinky Toy No. 60A). The "earth" was represented by a sheet of cardboard about 2 ft. square on which roadways and fields were painted in yellow and green. Sawdust dyed green was used for the hedges, and was stuck to the cardboard with gum. The line of the hedges was first drawn on the card with gum, and the sawdust then sprinkled over, the surplus being afterwards shaken off. The clumps of trees were made in the same way. To produce the photograph the "earth" was pinned vertically to a wall and the miniature aeroplane suspended about 15 in. in front of it, by means of fine black cotton. It is possible to obtain very striking pictures in this way, including aerial combats, or several machines flying in formation.

It is also great fun to make table-top photographs of river, sea, or dock scenes, using the Dinky Toy liners and warships as the models. A sheet of white muffled glass looks just like water in a photograph, and a piece of suitable size can be obtained quite cheaply from any glazier. The photograph showing the Cunard White Star liner "*Queen Mary*" at anchor, and the "*Queen of Bermuda*" steaming into harbour, was made in this manner. The sheet of glass was placed over dark blue paper and raised about ⅛ inch above it.

New Models—(*Cont. from page 115*)

Lumber Wagon and Horse

The wagon is made by bolting a pair of Trunnions and a pair of Flat Trunnions to a Flanged Plate for carrying the axles of the 1" Pulley Wheels. The Trunnions are bolted direct to the upper surface of the Plate, and the same bolts secure a 2½" × ½" Double Angle Strip, at the ends of which are Angle Brackets. A 2½" Strip is fixed between the Angle Brackets by ⅜" Bolts, the shanks of which protrude upwards. The Flat Trunnions are bolted to the side flanges of the Plate, and a Double Angle Strip is bolted between them. Two ⅜" Bolts are fitted to the Double Angle Strip to hold the logs in position.

Shafts for the horse are made from 5½" Strips secured to Angle Brackets, and the horse is formed from a 2½" × 2½" Flexible Plate that is bent to form the body and provided with 2½" Strips that are bolted to Angle Brackets and form the legs. A Flat Bracket is secured in place for a tail, and 2½" Curved Strips for the neck. Flat Brackets form the head. The horse is fixed in position by a 2" Axle Rod that is passed through the body and retained in the shafts by Spring Clips.

Parts required for Lumber Wagon and Horse:2 of No. 2; 5 of No. 5; 3 of No. 10; 8 of No. 12; 2 of No. 16 ;1 of No. 17; 4 of No. 22; 20 of No. 37; 4 of No. 37a; 2 of No. 48a; 1 of No. 52; 2 of No. 90a; 4 of No. 111c; 2 of No. 126; 2 of No. 126a; 1 of No. 190.

Miles Monoplanes—(*Continued from page 83*)

while the more powerful engine increases the maximum speed to 170 m.p.h. and the cruising speed to 150 m.p.h.

All Miles aircraft are available fitted with an attachment known as the Miles Split Flap. This has been developed by Mr. Miles, and consists of a number of narrow flaps about 7 in. in length that are arranged below the wing and fuselage of the machine a short distance in front of the trailing edge. The action of these flaps is to lower the speed at which the machine stalls and an aeroplane to which they are fitted is practically fool-proof. We hope to publish fuller details about the invention when more information concerning it is available.

December Mystery Photograph

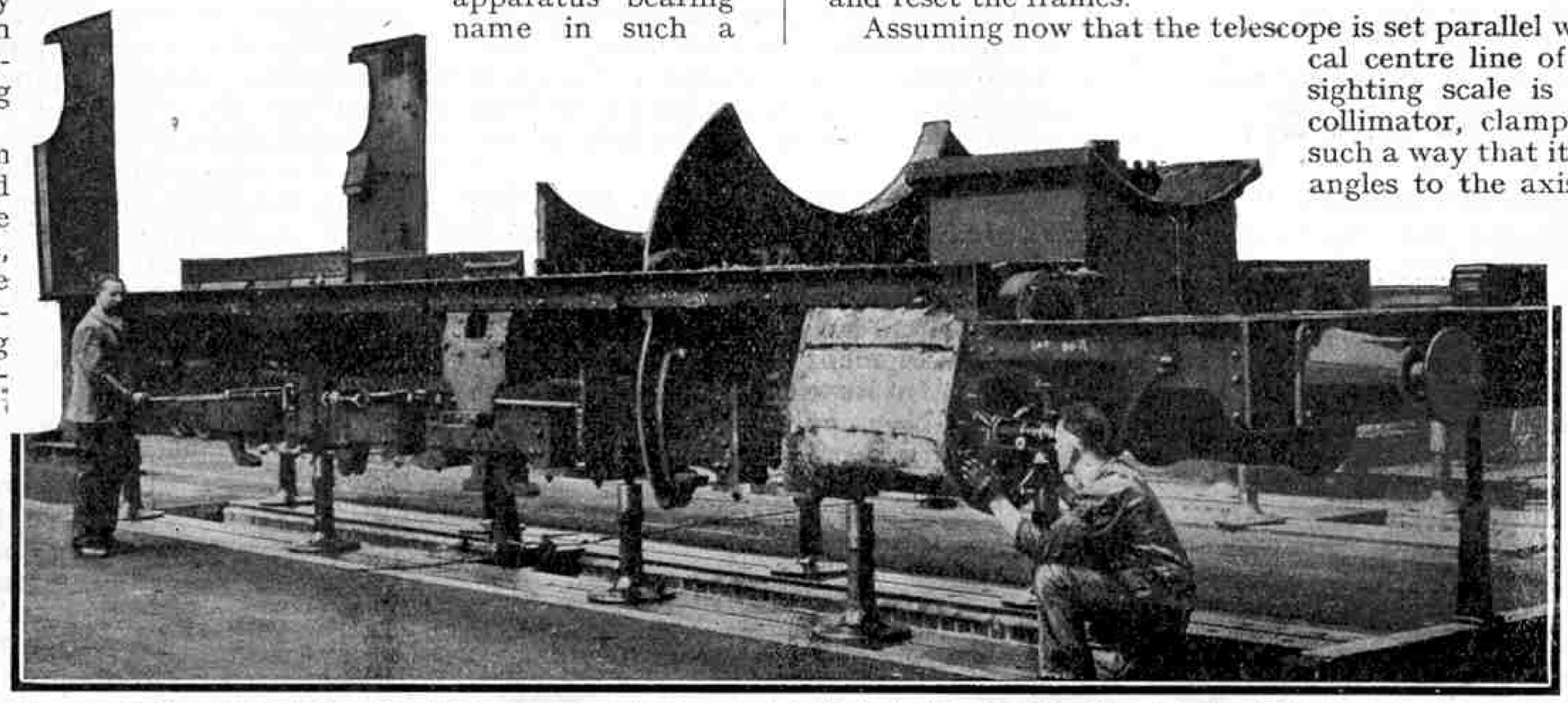
The photograph reproduced on page 1026 of the December "*M.M.*," in which the funnel and part of the superstructure of a ship seem inextricably mixed with girder work, wooden and iron railings and factory chimneys, proved to be no puzzle to readers, many of whom identified it correctly as a representation of the Manchester Ship Canal at Barton, where it is crossed by the Bridgewater Canal. The photograph was taken from the level of the upper canal when the aqueduct was open to allow the passage of vessels on the Ship Canal, and this explains the unusual character of the scene.

The Optical Lining-Up of Locomotives

By K. J. Cook

THE name of Zeiss has long been held in the highest regard by those who have sought perfection in such articles as prismatic binoculars and photographic lenses. It may seem a far cry from these articles of ultra refinement to the building and repairing of modern steam locomotives, and one may not expect to find any apparatus bearing this well-known name in such a place as a locomotive erecting shop.

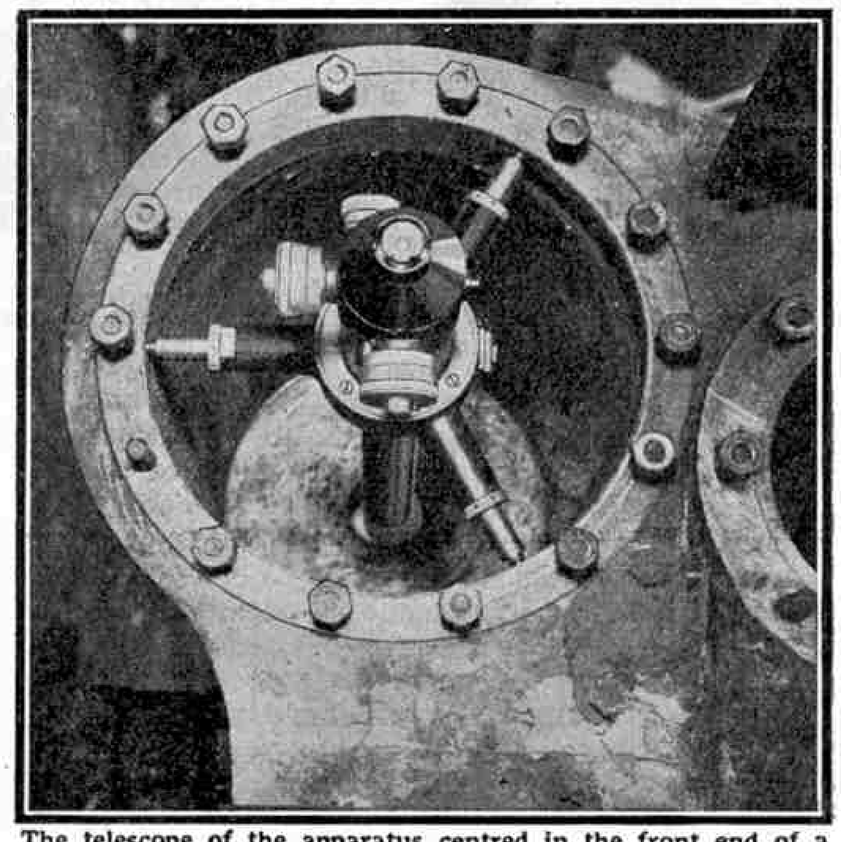
"Cheltenham Flyers" and "Kings" of the Iron Road have, however, to be built to ever-improving standards of perfection, for some of these engines are now running up to a quarter-of-a-million miles between complete overhauls. During their life they are subject to many distortions and strains; and that the latter part of their thirty years' life may be as smooth as their youth, it is not surprising that some extremely accurate means of measuring and setting or resetting their foundations should be desired. Such a means is now available in the Zeiss optical locomotive lining-up apparatus, the first of which in Great Britain takes a prominent place in the "A" Erecting Shop at the Great Western Railway Company's Swindon works.



A general view of the Zeiss optical lining-up apparatus in use at the Swindon Works of the Great Western Railway, to whom we are indebted for our illustrations.

The title of "lining-up" apparatus is apt to give, technically, a rather belittling impression of its uses, as in addition to providing an accurate means of measuring the alignment of frames and cylinders, it also enables very accurate measurements to be made of distances from cylinders to driving horn centres, and between driving and other horn centres, which are of the utmost importance. It is probably well-known that in locomotives an axle is securely keyed to its pair of wheels and revolves in axleboxes which are, in turn, housed in hornblocks or cheek blocks bolted to the main frames.

The Zeiss optical lining-up apparatus provides a telescope mounted within a tube. The telescope can be pivoted in vertical or horizontal planes by two dials, and when the dials are both set at zero the telescope is in exact central alignment with its external tube. This tube is set by a self-centring spider in the front bell-mouth of one cylinder, and by an adaptor in the stuffing box at the back of the cylinder. A spirit-level ensures that the vertical and horizontal axes are correct, and a measuring surface, set level with the front cylinder face by a straight-edge, provides zero for distance. The overall width across each pair of horns is measured by a vernier, and then a sighting scale is clamped to each horn in turn, and the scale read through the telescope.



The telescope of the apparatus centred in the front end of a locomotive cylinder.

The sighting scale is of a similar nature to a surveyor's staff, and the reading gives the distance of the cylinder axis to the outside edge of the horn. This distance, plus half the width over that pair of horns, gives the distance to the theoretical centre line of the engine. If this sum does not amount to the same total at each horn, the cylinder axis is not parallel with the centre line of the engine. A certain tolerance can be allowed here and the telescope pivoted horizontally until its centre is parallel with the engine centre line, but if the correction would be beyond the allowed limit, it may be necessary to cut down some stiffeners or cross-stays and reset the frames.

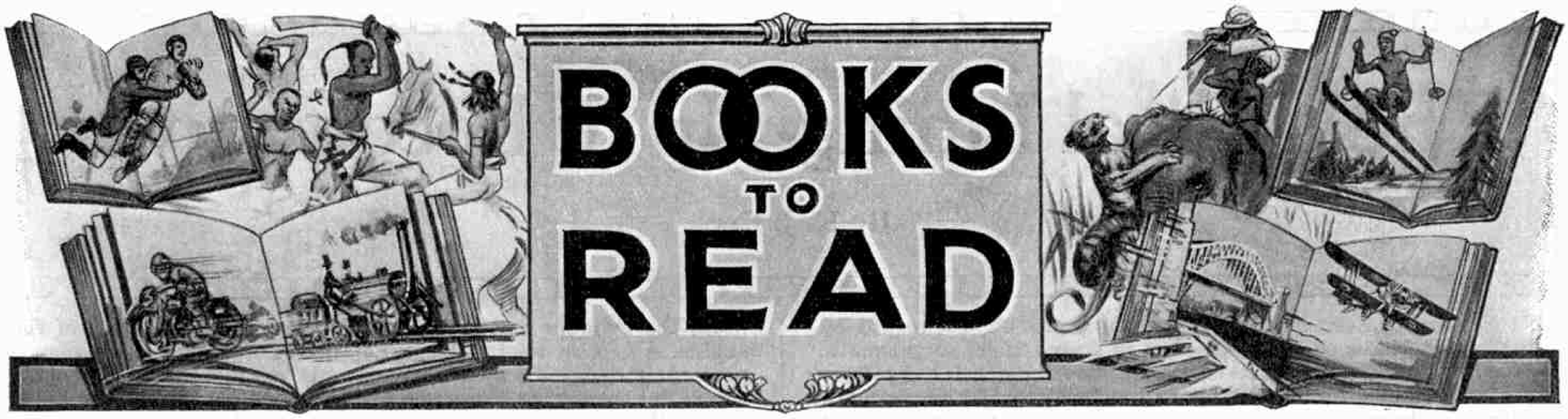
Assuming now that the telescope is set parallel with the theoretical centre line of the engine, the sighting scale is removed and a collimator, clamped to a tube in such a way that it is dead at right-angles to the axis of the tube, is supported at the driving horn, the tube being right across the frame between both driving horns. The tube is held in a stand, the top of which can be moved vertically, horizontally to or from the cylinder, and through an angle horizontally. The collimator is an optical apparatus which carries two sets of cross-scales illuminated by an electric lamp and has the property of accepting at zero, on its infinite scale, only rays parallel with the telescope.

If, on sighting from the telescope, the telescope cross-lines cut the horizontal and vertical lines of the infinite scale of the collimator at zero, then the telescope and the collimator are truly parallel. They may not be in the same plane, but they are parallel. How much they are out of plane can be read by focussing the telescope on the finite scale of the collimator and reading the graduations.

The horizontal, vertical, and angular adjustments provided in the collimator stand allow the collimator to be brought easily into alignment with the telescope. As the collimator is now parallel with the telescope and is fixed accurately at right-angles to the collimator cross-tube, it follows that the cross-tube is now between the driving horns at right-angles to the cylinder axis.

A dial indicator is used to obtain the distance of each horn cheek from the collimator cross-tube, and the latter is traversed longitudinally until it is central between the driving horns. The length gauge, with dial indicator, from gauging points on the telescope tube and the collimator tube, gives a direct reading of the distance from the cylinder face to the centre of the driving horn, and from the collimator cross-tube a locating stud on each frame is set at a definite distance from the horn centre. Similar locating studs are set at the other horns, i.e., leading, intermediate, or trailing, from those at the driving horns by means of gauge rods whose lengths are the designed distances from the driving to the other horn centres. It follows that these locating studs are thus set at the same distance from the desired centre lines of the other horns as the first ones are from the driving horn centre line.

The actual centre lines for the other horns are obtained by supporting a straightedge across the frames at a set distance from the locating studs. It is then a very simple (*Continued on page 94*)



Here we review books of interest and of use to readers of the "M.M." We can supply copies of these books to readers who cannot obtain them through the usual channels. Orders from Book Dept., Meccano Limited, Binns Road, Liverpool 13, adding 1/- for postage to the price. Postage on different books vary, but any balance remaining will be refunded.

"The Romance of Engineering"

By Dr. A. D. MERRIMAN, M.A., M.I.Mech.E.
(Harrap. 7/6 net)

In this popular account of engineering the author has traced the main lines of progress from the very earliest times in order to enable him to introduce the stories of the pioneers who laid its foundations, and of the famous engineers who have contributed to its advancement. The result is a continuous story that will give young readers an adequate idea of the part that engineering plays in modern life, and the manner in which it has helped in the development of civilisation in general. It is suitable as an introduction to engineering science for boys who intend to follow it as a profession.

A preliminary chapter deals with engineering in antiquity, and tells the story of Archimedes, the Greek scientist who regarded mechanics as ignoble and sordid, but devised so many useful contrivances that he is now called the "father of mechanics." Another early engineer was Hero, or Heron, of Alexandria, the inventor of the steam engine, and a description of his invention introduces the story of steam, to which the next five chapters are devoted. No further progress seems to have been made until the 17th century, when several elaborate devices that look effective on paper, but probably were never constructed, were described. The first man to make real use of steam appears to have been the Marquis of Worcester, an engineering genius who, about 1655, invented a fairly successful steam pump that lifted water to a height of 40 ft. The Marquis also invented a famous device for securing perpetual motion, and the author shows conclusively why this and similar contrivances failed.

The age of steam can really be said to have begun with Papin, a French refugee who invented a digester, or boiler for softening bones, and developed it into a steam pump. Papin was followed by Savery and Newcomen in England, and interesting details are given of the engines built by the latter, which to us look clumsy, but were a wonderful advance on anything previously constructed. James Watt then comes into the story, and we learn how the many improvements he effected transformed the Newcomen engine into a far more efficient source of power, and ushered in the age of steam in industry. This is one of the most fascinating stories in the history of engineering.

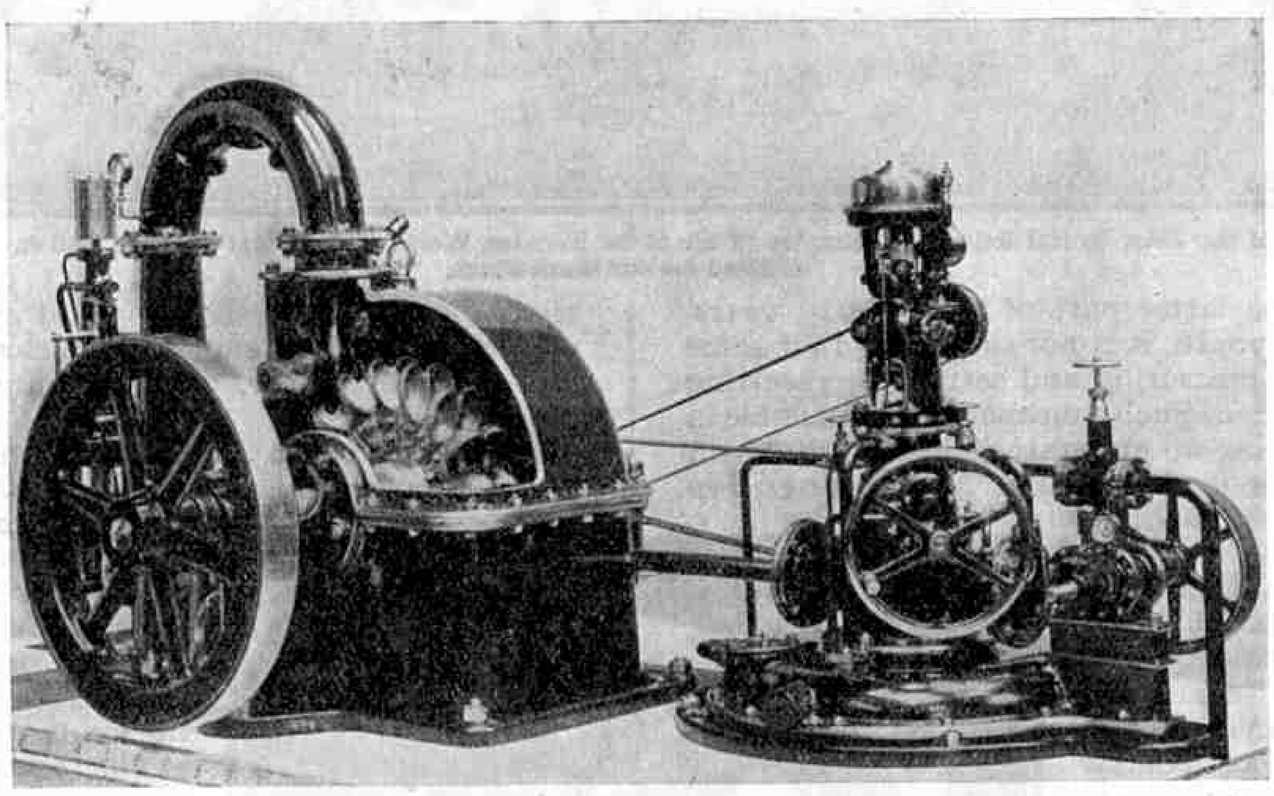
While full credit is given to Watt, the work of his rivals is not overlooked, and in particular the introduction of high-pressure engines by the wayward genius Richard Trevithick, and his wonderful pioneer work on the development of locomotives, is fully explained. In its earlier days the steam engine had been applied chiefly to pumping water out of coal and tin mines, but Trevithick showed that it could be used for transport on land. Symington, Bell and Fulton were equally successful on water, and the author completes his story of the steam engine by tracing the development of steam ships and steam locomotives. In each case the story is told as fully as space permits, and many little-known details of the earliest stages of these developments add largely to its interest. Early locomotives are dealt with in a particularly attractive manner. Some of these were of peculiar design, and one of them could almost literally be described as an "iron horse," for it actually had legs that took strides more than two feet in length as it moved!

From the steam engine the author turns to the internal combustion engine and to the conquest of the air that it eventually brought about. It will surprise many readers to learn that gas engines were constructed more than 100 years ago, and the manner in which these led up to the petrol engine, and the still more recent heavy oil engine, is explained in detail. The chapter on the conquest of the air contains accounts of amusing early suggestions for flying machines, in one of which tame eagles supplied the necessary power; and interest increases as the development of the balloon and the aeroplane are traced. In many respects flight is the most romantic achievement of the engineer. The story is yet far from complete, but immense progress has been made since the first flights of the Wright Brothers; and the author is able to point out that Imperial Airways have had only four accidents in regular commercial flying covering more than 6,000,000 miles.

The engineer is concerned also with other sources of power, and the next three chapters show how the wind, streams and waterfalls, and the Sun have been harnessed. The windmill has had a very interesting history, but is now almost obsolete. The water mill preceded the windmill, and in its turn decayed, but water power in another form now furnishes us with electrical energy on an ever-increasing scale. Efforts to harness the Sun directly have had limited success so far, and as yet it is cheaper to use this power indirectly by burning coal, which represents plant life nourished by the Sun millions of years ago, or by utilising wind and water power.

Finally the author reviews the constructional work of the civil engineer. In successive chapters he deals with the romance of the lighthouse; the erection of the breakwaters that make our harbours safe, and of the dams that harness the power of great waterfalls; the construction of bridges, and the boring of huge tunnels. In all cases he traces the development of the type of structure he is dealing with, and describes recent examples as illustrations of the principles involved. This section of the book contains also an account of the making of iron and steel, the most important of the metals used by the engineer. The author gives interesting details of the ruins of a Roman forge at Stratford-on-Avon, and of other primitive furnaces, before explaining the growth of the iron and steel industry in more modern times. The invention and triumph of the steam turbine also is dealt with, and the manner in which various types of this efficient form of steam engine work is fully described.

Good illustrations are essential in a book that deals with the story of a science that is so closely connected with our daily lives, and this volume contains 23 plates, and 12 drawings or diagrams in the text.



The Pelton Wheel, an impulse type of water turbine. This illustration, and those on the opposite page, are from "The Romance of Engineering" reviewed on this page.

"Romping Through Physics"

By Otto Willi Gail (Routledge. 4/6 net)

There is nothing very terrifying in "physics," the science that deals with, among other things, heat and the general properties of matter; and this book, translated from the German by H. S. Hatfield, is intended to show in an entertaining manner, how this science explains many matters that we encounter in everyday life, and solves curious problems that often puzzle ordinary people.

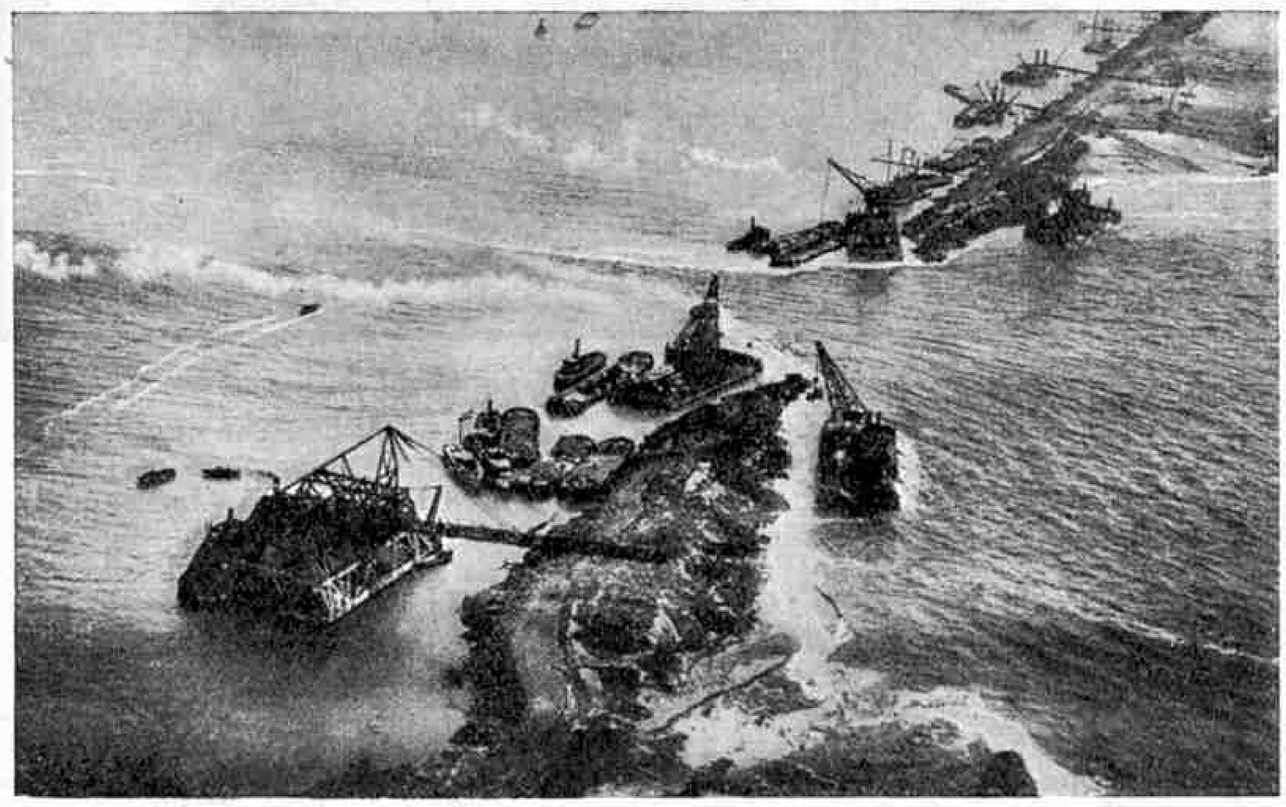
The story begins in homely fashion in the kitchen, with explanations of the best means of boiling water, and of keeping coffee hot without boiling it. This leads to the curious fact that liquids can be made to boil by cooling them, a paradox that in turn brings us to an interesting discussion on air pressure, in the course of which we realise why it would be difficult to make good tea or coffee, or to boil eggs, on the top of a high mountain, or on the planet Mars, where atmospheric pressure is very low. The introduction of eggs gives an opportunity of talking about balance and the effect of rotation on balance, for an unboiled egg cannot be made to spin, whereas a boiled one spins readily.

The author is now well into his stride, and one absorbingly interesting topic after another is dealt with at high speed and in a breezy manner that justifies the title of the book. How much does a flying fly weigh? If a man dropped into a shaft driven through the centre of the Earth, how long would it take him to reach the other side, and what would happen when he arrived? Why does the weight shown on an automatic weighing machine change when one bends down, or when the arms are waved about? Can a pistol be fired at the deepest point of the oceans, where the water pressure is seven tons per sq. in.? Where do sunken ships go to? All these and many other puzzling questions are answered in an admirably easy and straightforward manner, and the reply often is very surprising.

The climax comes when the effect of the Earth's rotation on the weight of objects on its surface is considered. We learn that a fat Eskimo weighing 200 lb. would lose nearly a pound in weight if he were transferred from Arctic regions to the Equator, but would regain it immediately on returning home! This is explained as partly due to the centrifugal effect of the Earth's rotation, and the author then asks us to imagine what would happen if the spin of the Earth were speeded up so that the day lasted only an hour and a half. At the Equator centrifugal force then would balance gravity, and nothing there would have any weight. Buildings, elephants and other creatures, and trees and human beings would drift upward into the air, only to be swept northward or southward by violent winds. Those whirled to the north would be rained down on London, New York and other places, and the inhabitants of the temperate zone who survived the visitation would find it necessary to lean at an angle toward the north to balance centrifugal force, and would find it comparatively easy to walk up the north side of a house as a fly climbs up a wall! Only at the poles would there be no change, but a polar bear who ventured too far away from that haven of refuge would find himself irresistibly pushed southward and unable to return! Fortunately no catastrophe of this kind is likely to happen, for the Earth is slowing down rather than speeding up; but the story of the astounding results of this imaginary increase in the speed at which it turns helps to show how we depend on Nature's laws for our very existence.

The book is full of interest, and the 103 coloured drawings illustrate the text in an appropriately humorous manner that adds largely to its attractions.

Sydney Harbour Bridge, the largest arch bridge in the world.



Filling in the last opening in the dike built to reclaim the Zuider Zee, Holland.

"Sands, Clays and Minerals"

(A. L. Curtis. 3/6)

This magazine is published quarterly by A. L. Curtis, Chatteris, England, for the benefit of those interested in the production and use of economic minerals of all kinds. The present issue contains 124 pages of valuable technical articles that fully maintain the high standard of previous issues, and also includes contributions dealing with matters of interest to the ordinary reader, such as the pearl diving industry of the north-west coast of Australia, and the efforts to find oil in Great Britain. A special feature is the first instalment of a reprint of a work on the minerals of Cornwall by M. H. Klaproth, a famous pioneer chemist and mineralogist of the 18th century, which gives a fascinating account of tin mining 150 years ago. The issue is well illustrated by means of 34 excellent photographs and drawings, and its contents will appeal to those "*M.M.*" readers who are interested in chemistry and its industrial applications.

"Suns and Worlds"

By W. H. Steavenson
(A. & C. Black Ltd. 2/6 net)

Although the author of this introduction to astronomy claims that the science dealt with is one of the simplest branches of knowledge, it is by no means easy to compress into a short book an adequate review of our present-day knowledge of the subject. Dr. Steavenson has succeeded in giving a valuable outline of astronomy as far as it can be understood without mathematics. He has dealt throughout with results rather than with the methods employed by astronomers, and his book will be appreciated by all who are attracted by the problems presented by the Sun and the stars.

An excellent introduction considers the Earth as a viewpoint, and not only explains the difficulties that astronomers have to contend with in studying their subject, but helps to form a convenient starting point for the journey through space that occupies the rest of the book. Naturally an account of the solar system occupies the next few chapters, and what we know of conditions on the Sun and on the planets is explained briefly but adequately. From our own Sun we pass to the stars, or other suns, and the author shows how they differ in size and in brilliance, and how we have learned to read their histories.

The final chapters will be found less easy by the average reader, but the effort to follow them will be well worth while, for they form an outline of modern views of the Universe as a whole. In them the author shows how the study of change and motion in the heavens has told us something of the nature of the galaxy of stars of which the Sun and his family form a comparatively insignificant portion, and of other galaxies beyond our own. This study also has shown us that the great nebulæ are running away from us at amazingly high speeds, and that the Universe in fact is rapidly expanding.

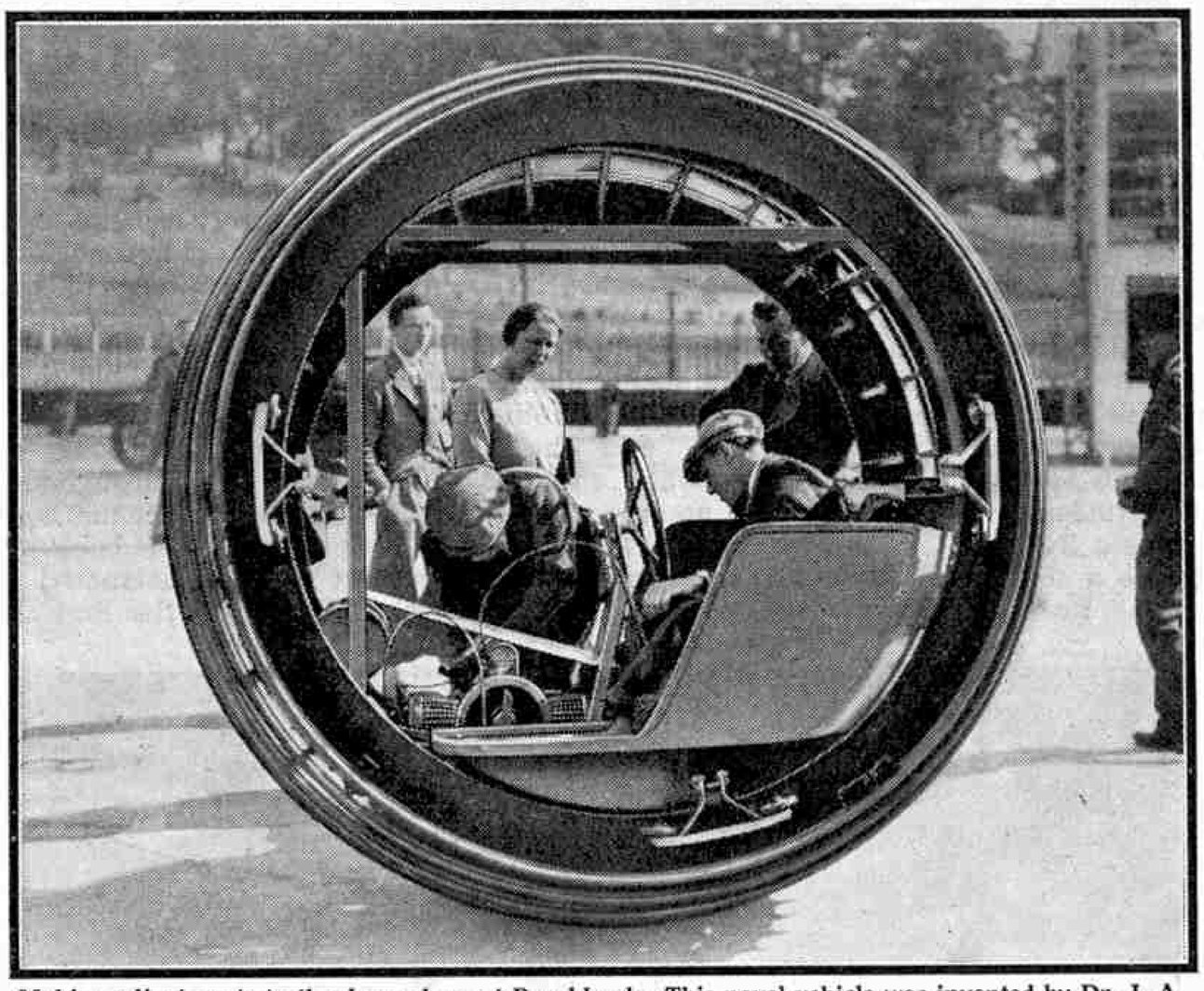
Motoring Inside A Wheel

Novel Vehicle That Rolls Like A Ball

THE wheel has been described as the most brilliant of the inventions of Man, and it is certainly true to say that the world runs on wheels, for we have travelled on wheels from prehistoric days. The chariots of the ancients and the four-wheeled carts of the Romans have been followed successively by the wagons and clumsy carriages of the Middle Ages, by the stage coach and other horse-drawn vehicles of later days and by the railway train and motor car of modern times, and with each advance there has been a great increase in speed and comfort.

Improvements also have continually been made in the surfaces on which these run, for the wheel and the road have been associated with each other since the beginning of civilisation. The steam and electric locomotives of to-day run on roads formed of steel rails, while rubber tyres enable motor cars, omnibuses and lorries to travel at high speeds on the prepared surfaces of our highways. To some people such developments may seem to be the final stage in the development of transport on land, and these look to the air as the future highway. We may look forward to equally revolutionary changes in regard to land transport, however. The introduction of creeper track is evidence of this, and motor cars and lorries equipped with these are to a large extent independent of road surfaces, so that they can be used for travelling over rough ground and for penetrating into undeveloped regions.

Another invention that gives promise in this direction is illustrated on our cover, which represents what is called the "dynasphere." This novel vehicle is the invention of Dr. J. A. Purves, Taunton, and is capable of rolling along roads, or over fields and wild country, as easily as a ball runs along a smooth surface. The dynasphere of course is yet in the experimental stage, but it possesses so many advantages that we may eventually see gigantic wheels similar to that shown on our cover running along our highways in as large numbers as motor cars do to-day.



Making adjustments to the dynasphere at Brooklands. This novel vehicle was invented by Dr. J. A. Purves, Taunton, to whom we are indebted for our illustration.

The idea of the dynasphere is very simple. The engine, transmission and bodywork form a unit that travels on rails inside a spherical cage. When the engine is in action, this unit tries to climb up the side of the cage, which is made to revolve by its weight, and thus the great wheel is impelled along the road as readily as if it were driven directly by the engine. In this case, however, there is no tractive effort at the point of contact of the wheel with the ground, and the movement is purely one of rolling.

The great wheel of the dynasphere is not a complete sphere, but the median section left after the sides are cut away. and an idea of its shape can be obtained by imagining a cricket ball with the smooth-surfaced sides cut away to leave only the part enclosed by the seam. The remaining surface of the sphere also is partly cut away in order to provide the necessary visibility and the part that actually comes into contact with the ground therefore consists of a series of connected rings. These rings are 10 in number. Each is 7 ft. 6 in. in diameter and from one side of the device to the other measures 4 ft. The rings are provided with small solid leather tyres and are inclined progressively outward so as to offer as little obstruction as possible to the view of the driver of the vehicle, whose seat is in the interior of the wheel.

One of the most remarkable features of the dynasphere is the low power necessary to give efficient and speedy movement. A two-cylinder air-cooled Douglas engine of 6 h.p. is installed in the experimental vehicle and a gear-box with three speeds forward and one reverse is fitted. The drive is taken through a chain to the main axle of the unit that runs on the rails inside the dynasphere. The driving wheels of this unit are only 7 in. in diameter and 1 in. in width, and the rails on which their metal edges run have Ferodo linings.

Steering is simple but effective. As the dynasphere is in effect a single wheel, the driver could steer it by moving to one side or the other in order to tilt it, as is sometimes done on a bicycle. This of course would not be efficient and instead the driver moves the rails across the vehicle by means of gearing controlled by a steering wheel of the ordinary type. The movement of the rails tilts the great roller and causes it to turn to left or right, the unit within the vehicle meanwhile remaining upright. In trial runs the driver executed some remarkably sharp turns by leaning out on one side of the dynasphere in order to increase the effect of his movement of the steering gear.

The dynasphere is controlled very much in the same manner as an ordinary motor car. It is braked by simply switching off the engine, when the bodywork within it tends to swing backward and thus checks the movement of the sphere, and a special brake is provided to keep it stationary on a gradient. Speeds of 30 m.p.h. can be obtained with the experimental model already built, but of course much higher speeds could be obtained with specially designed dynaspheres.

The vehicle travels backward and forward with equal ease. When the engine is started and first gear is engaged, the forward movement of the bodywork and engine unit as it begins to climb up the sphere is immediately noticeable. Its weight quickly sets the vehicle in motion, however, and then it returns to its normal position. Stopping the engine has the reverse effect, for then the unit begins to back up the rails and as it strives to climb up the rails its weight opposes the forward movement of the sphere.

At present it is impossible to say what may come of this invention, but it has so many advantages that further developments will cause no surprise. As the wheel simply rolls along, and there is no effort, and practically no wear, at the point of contact with the ground, the cost of maintenance should be comparatively low and the vehicle should be durable. The bodywork and the engine move lightly on the rails and the easy motion of the sphere itself is comfortable for the driver and passengers, and the simplicity of construction would make the vehicle comparatively cheap to build. It is claimed that the dynasphere can achieve all that is asked of passenger-carrying vehicles, and even if it is never brought into use on a large scale on the roads of civilised countries, it may prove invaluable for work in others that are not so well developed. There it will have the further advantage of making unnecessary the construction of the costly roads that are required for the heavy traffic of modern times, for there is practically no wear on the ground over which it travels, or tendency to disintegrate it, because of the easy rolling movement and the single point contact with the surface.

The Belah Viaduct

An Interesting Westmorland Structure

THE slender-looking structure shown in the accompanying photograph is the Belah Viaduct in Westmorland, situated on a line remarkable for the boldness of its engineerng, the former North Eastern, now L.N.E.R., route from Darlington to Tebay, by way of Barnard Castle. This was originally the South Durham and Lancashire Railway, and was intended to "unite the manufacturing districts of Durham, Northumberland and Cleveland with those of Lancashire and the West." In the development of the Cleveland iron industry it had been found that better results were obtained by the addition of Lancashire ore to the local ironstone, and consequently quantities of this ore had been passing from Lancashire to the north-east, but by a roundabout route, via Carlisle and Newcastle.

In order to shorten this journey, the South Durham and Lancashire was incorporated in 1857. It was worked by the Stockton and Darlington Company from its opening in 1861, and was absorbed by them in 1863, shortly afterwards passing with that line into the hands of the North Eastern Railway Company. It was a bold project, the line being carried across the wild moorland country over the Pennines, reaching at the summit of Stainmore an altitude of 1,369 ft. above sea-level. Deep gorges break up this mountainous district, necessitating the numerous viaducts on the line, of which Belah Viaduct is the most notable. Some of these structures are of iron and some of stone, the largest of the latter being Smardale Viaduct, which is 553 ft. long and 90 ft. high. Of the three most important, the Belah, Deepdale and Tees viaducts, the first two are wholly of iron, while the third has its wrought iron lattice girder portion supported on stone piers.

Belah Viaduct, which cost £31,630 to build, attains a maximum height of 196 ft., and is 1,040 ft. long, being made up of 16 spans of 60 ft. each. Iron was selected as the material on account of the rapid construction possible with it. The foundation stone was laid on 25th November, 1857, and at a meeting of the company held on 14th February, 1860, the engineer declared the viaduct completed. The superstructure is of the wrought iron lattice girder type, resting on tapered piers of cast iron columns braced together by cast iron struts and wrought iron tiebars. Each pier consists of six columns 12 in. in diameter, 50 ft. wide at the base, and tapering to 22 ft. wide at the top, arranged in two parallel lines of three each, braced together at intervals of 15 ft. This construction is well shown in the photograph in which a mineral train is seen crossing the viaduct.

The line on which the viaduct is situated ascends from Kirkby Stephen on its way to the summit of Stainmore, descending from there to Barnard Castle. The summit is the highest point reached by passenger trains on the L.N.E.R. and as the gradients are steep, assistant engines are sometimes necessary. The concentration of weight on the viaduct makes piloting impossible, and so the assistant engine is always attached to the rear of the train. Trains in the downhill direction towards Kirkby Stephen, travelling with steam shut off, cause a sudden noise in passing on to the viaduct, and this is often mistaken for thunder by strangers.

It is interesting that on the stonework of one of the buttresses the following rhyme appears:

"To future ages this rhyme will tell
Who built this structure o'er the dell
Gilkes Wilson with his eighty men
Raised Belah's viaduct o'er the glen."

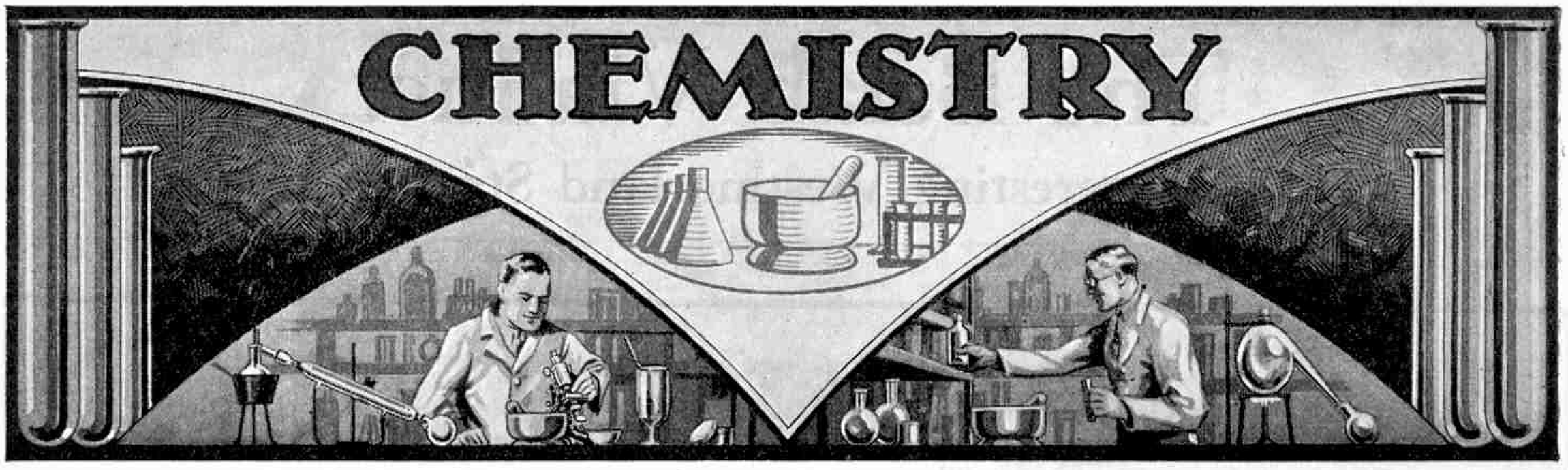
Like the other viaducts and bridges on the line Belah Viaduct was made wide enough for two tracks, although only one was laid at first.

Belah Viaduct in Westmorland, showing the form of construction described in this article. Photograph by E. R. Bousfield, Liverpool.

Although the Stockton and Darlington system was amalgamated with the North Eastern in 1863, it was managed independently for 10 years afterwards by a joint committee. Similarly the locomotives were kept separate from North Eastern stock, and numerous engines were built to Stockton and Darlington designs until 1874 for service on that section of the line.

For the haulage of the mineral traffic that was the chief reason for the construction of the line, more powerful engines than those previously in service on the Stockton and Darlington Railway were ordered. The first were delivered in 1860, and were of the 0–6–0 "long-boiler" type, having all three axles below the boiler barrel, with the smoke-box and fire-box overhanging. These were provided with the form of feed-water heater known as "Bouch's coffee can." A water jacket was formed round the chimney, and the heat of the exhaust steam and gases was used to raise the temperature of the feed-water pumped into the "can" from the tender. Another feature was the comparatively large cab with roof extended backward to shelter the enginemen when passing over the wild heights of Stainmore. This class of locomotives was successful, and became the prototype of subsequent mineral designs on the North Eastern until the introduction of more modern types.

Of the locomotives for passenger traffic, two 4–4–0 engines built in 1860 were remarkable in that they were provided with large side-window cabs similar in general appearance to those standardised much later on the North Eastern system. These two engines were named *"Brougham"* and *"Lowther."* It is curious that some similar but slightly larger engines built a year or two after these were not provided with the large cabs, nor any form of shelter at all for the enginemen except plain weatherboards; and the commodious cabs of the original two were subsequently replaced by the more open erections favoured on the Stockton and Darlington Railway.

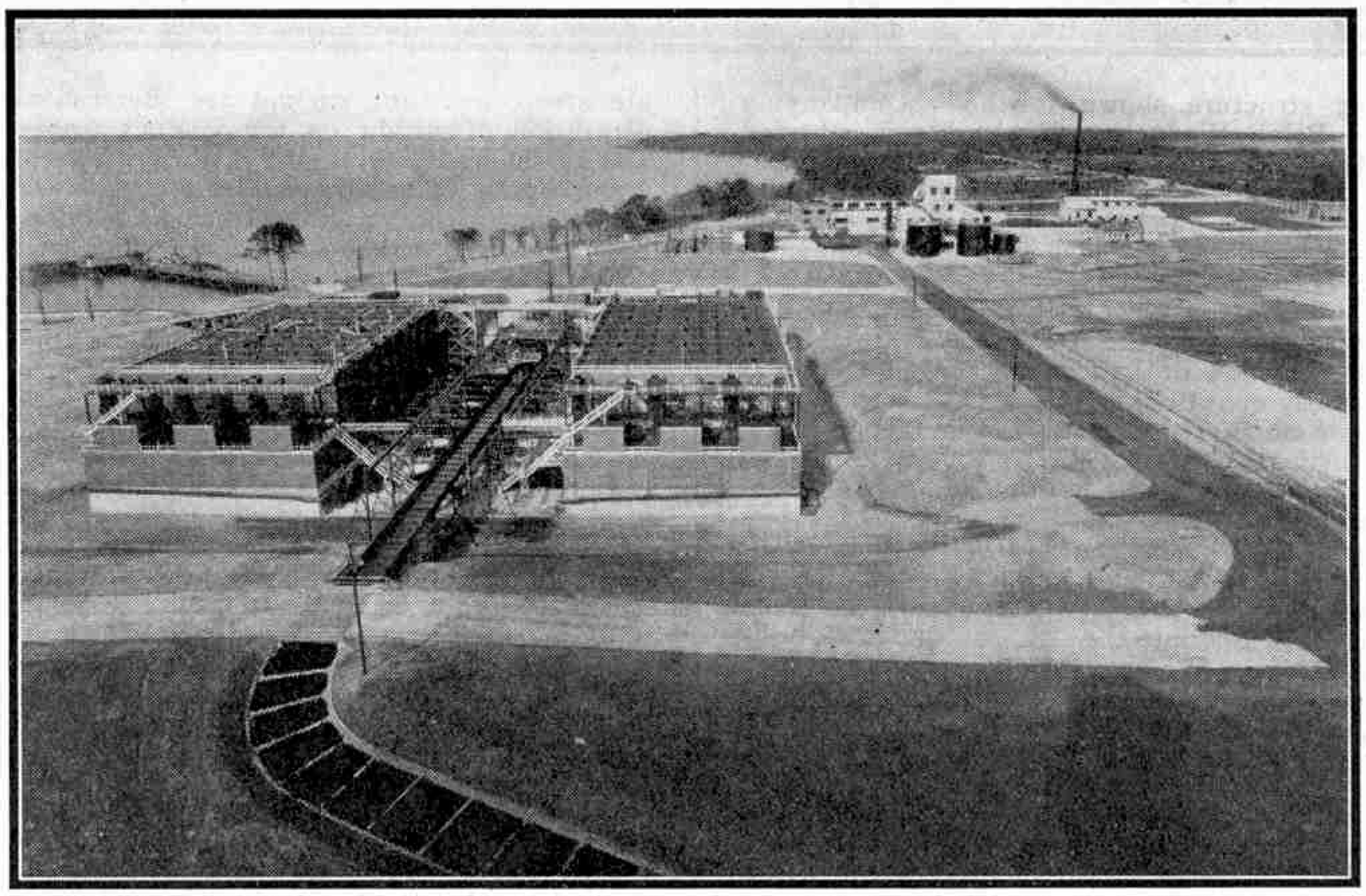


WEALTH EXTRACTED FROM SEA WATER

SEA water is an immense reservoir of chemicals carried down into the oceans by the rivers that flow into them, and almost every known element has been recognised in it. By far the most abundant of the substances in it of course is common salt, to which it owes its characteristic taste. Sea water in fact contains so large a proportion of salt that it was long regarded as one of the principal sources of this chemical, especially in warm countries where the heat of the Sun could be used to evaporate it in lagoons, or in shallow tanks filled at high tide. Almost all the salt we use to-day came originally from the oceans of millions of years ago, however, for it is derived from deposits left in the Earth when prehistoric seas dried up, and is extracted either by direct mining, or by pumping brine from the subterranean salt beds and evaporating it in vacuum pans.

Since the oceans seem to be of comparatively small value as sources of the most abundant of the substances contained in them, the prospect of obtaining other chemicals from sea water appears to be remote, for these constituents are present in very much smaller proportions than salt. One of the most important of them is magnesium bromide, which contains the important element bromine. It has been estimated that there are 120,000 million tons of bromine in the sea, but so enormous is the quantity of water in which its compound with magnesium is dissolved that there are only 70 tons of it in every million tons of sea water. It is therefore scarcely surprising that until recently the possibility of obtaining bromine from the oceans has been disregarded, especially as it could be obtained in sufficient quantity from other sources. An increased demand for bromine, chiefly for use in the production of Ethyl petrol, compelled chemists to turn to the magnesium bromide in the sea as a possible source of the greater quantity required. Immense difficulties were encountered in devising methods for extracting it, but eventually these were overcome, and to-day the waters of the Atlantic Ocean are being made to yield bromine by a process that undoubtedly is one of the greatest triumphs of the industrial chemist.

Bromine has had a very interesting history. It was discovered in 1826 by A. J. Balard, a French chemist, who extracted it from the water of salt marshes in France, but it had previously been obtained from a salt works in Germany by J. W. Liebig, who is best known to most people as the originator of the famous extract of meat that bore his name. Liebig did not recognise it as a new chemical element, and did not examine it thoroughly, for he thought it was a compound of iodine and chlorine with which he was already familiar. He realised his mistake when he heard of Balard's experiments, and in after years was accustomed to show to his friends a cabinet in which his own product stood, along with other reminders of mistakes he had made in his youth, and to explain to them how his carelessness had lost him the honour, greatly coveted by chemists, of discovering a new element.



The twin plants near Wilmington, North Carolina, U.S.A., in which bromine is extracted from sea water. The illustrations to this article are reproduced by courtesy of the Dow Chemical Company, Michigan, U.S.A.

Bromine is a heavy red liquid that has a very unpleasant and irritating smell. It derives its name from this peculiarity, for the word "bromine" comes from *bromos*, a Greek word meaning a disagreeable odour. In combination with other elements it is present in most salt deposits and natural brines, and for many years the source of the greater part of the world's supply was the thick beds of salt left behind on the evaporation of a great arm of an ocean that in prehistoric times extended over the Stassfurt district in Central Germany.

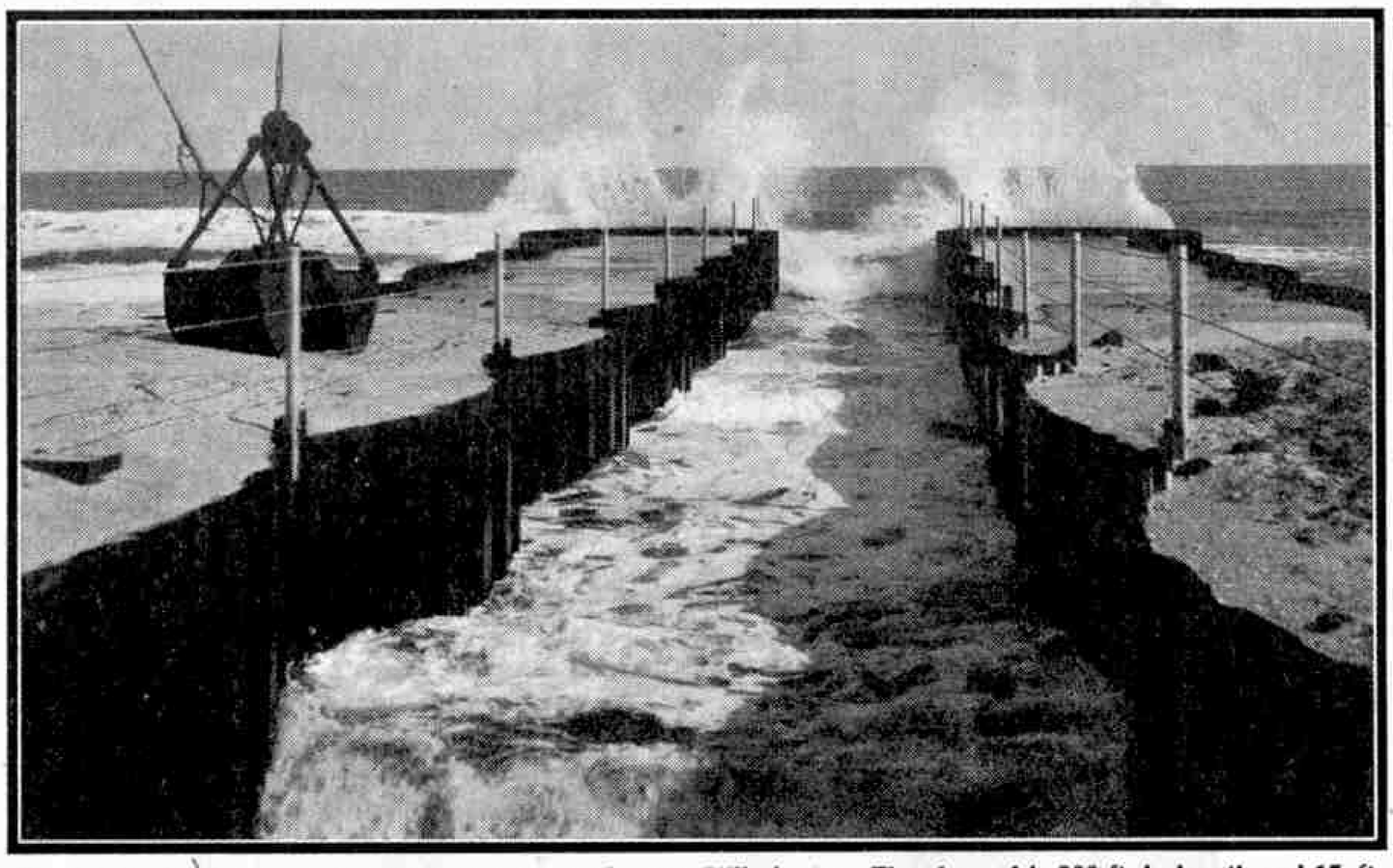
Now that the sea is a regular source of bromine, it is interesting to realise that at one time the element was obtained indirectly from the Atlantic Ocean. Certain forms of sea weed cast up on the western shores of Ireland and Scotland during great storms contain magnesium bromide and other salts absorbed from the sea water, and formerly they were collected and burned to form an ash, known as kelp, from which the bromine and other chemicals were extracted. The process fell into disuse when it was found that the most valuable kelp products could be obtained more cheaply from other sources.

The enormous quantity of sea water that had to be treated constituted one of the great difficulties confronting chemists when efforts first were made to use the ocean as a source of the chemical. The earliest efforts were made in 1924, when a small scale plant was built for the purpose, to be followed a few months later by a similar plant erected on a boat moored off the American coast.

For various reasons these experiments were abandoned, and the Dow Chemical Company then took up the enterprise. At their great works in Midland, Michigan, this company was already making bromine from natural brines pumped from deep wells, and now devoted many years of experience and effort to the problem

of using salt water from the oceans in place of the more concentrated brines pumped from the Earth. How difficult the task was can be gauged from the fact that sea water contains about the same proportion of bromine as the waste products flowing out of the plant in which the element is extracted from natural brines.

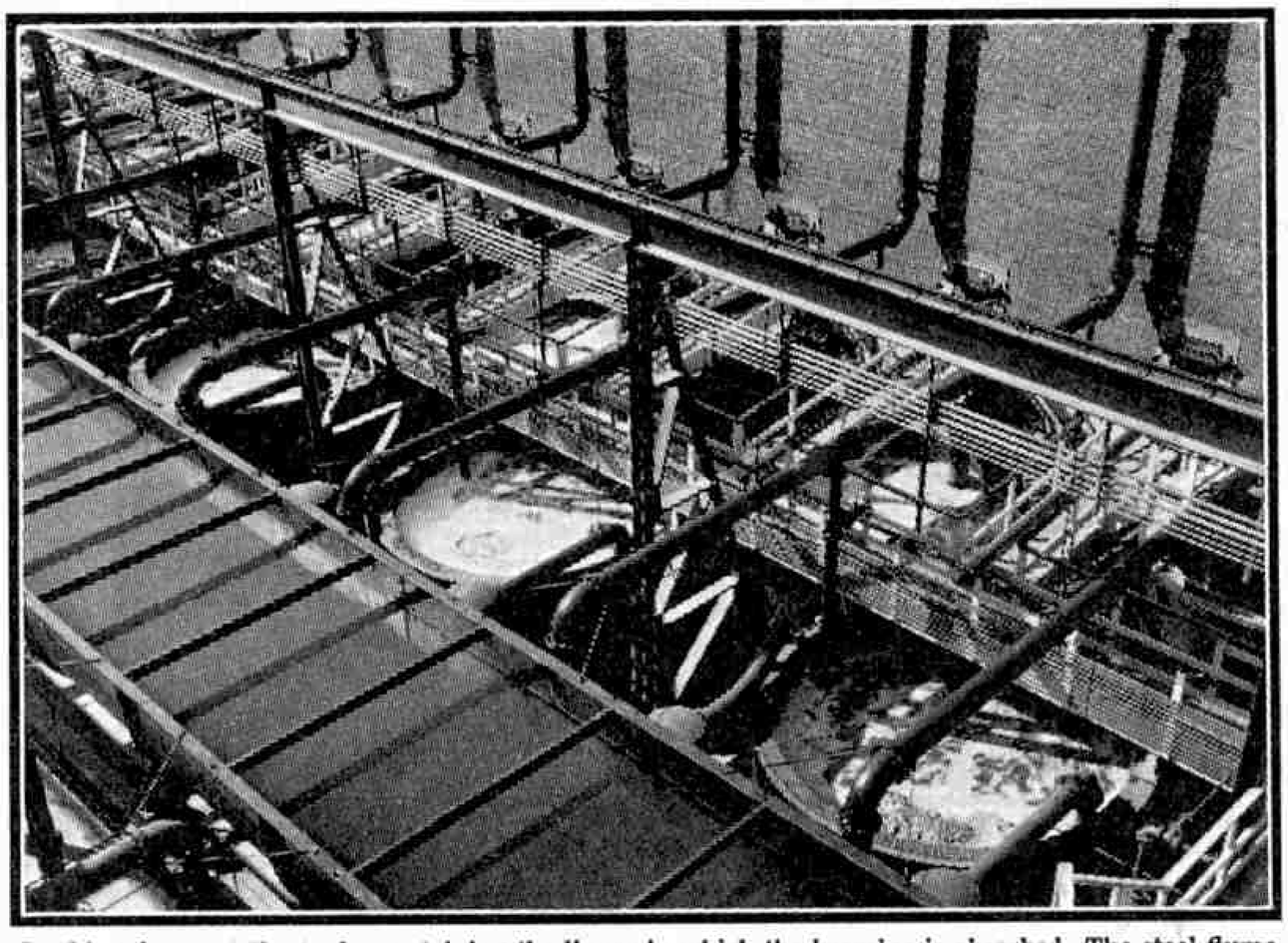
Eventually a process was worked out that promised success. It was practically the same as that already in use for stronger brine pumped out of the Earth. The sea water was first made slightly acid by the addition of a carefully measured proportion of sulphuric acid and treated with chlorine. A current of air was next blown through the liquid. This carried the bromine with it in the form of a vapour that was absorbed by a solution of soda ash, or sodium carbonate. Bromine liberated by adding sulphuric acid to this liquid was driven out by steam and condensed to the familiar red liquid.



The intake for the sea water at the bromine works near Wilmington. The channel is 200 ft. in length and 15 ft. in width, and is protected by double rows of interlocking steel sheet piles.

The discovery of a practicable chemical process was only a preliminary step and much hard work was necessary in order to achieve industrial success. The plan was tried first with artificial sea water, and then with real sea water carried in tanks to the Dow plant at Michigan. These experiments seemed to show that sea water could be made to give up its bromine at a reasonable cost, and search was made for the best site for a trial on a larger scale. This had to be on the coast, for clearly it was impracticable to carry the sea water to the plant, and before a decision was made samples of sea water were taken during a boat trip from New Orleans to Havana, and from there to New York. It was found that the percentage of bromine was approximately the same throughout, and as the water of the Gulf of Mexico was of no greater value than that of the Atlantic Ocean, it was decided to erect the plant on the Atlantic coast.

The next point to be considered was the disposal of the water from which the bromine had been extracted. This had to be discharged at a distance from the source of the sea water used in the plant in order to prevent dilution; and for this reason a peninsula between the ocean and a river flowing into it seemed to offer an ideal position, as the sea water could be taken in on one side and discharged on the other, after treatment. There is a peninsula of this kind between Cape Fear River, in North Carolina, and the Atlantic Ocean. It juts out southward, and as the fresh water of the river itself turns southward on reaching its mouth, the waste sea water poured into it from a factory established on the peninsula would be carried away from the intake. A pilot plant to give 500 lb. of bromine a day therefore was built on this site, and operated for six months, and the results were so successful that it was decided to design and construct a larger plant with an output of 15,000 lb. a day.



Looking down on the tanks containing the liquor in which the bromine is absorbed. The steel flume from which sea water is pumped into the extraction plants is seen in the lower left-hand corner.

Work on the new scheme began in 1933, and was completed within five months. Many intricate problems of engineering had to be solved before production began. One of the chief difficulties was that of transport, for the nearest railway station was at Wilmington, about 20 miles away, and all the necessary implements and building materials had to be delivered by motor lorry. The area to be cleared was 90 acres, and the erection of the buildings involved the laying of nearly 4,000,000 bricks and the use of nearly 9,000 cu. yds. of concrete with 425 tons of steel reinforcement. In addition, 350 tons of structural steel were required and 38 miles of electric wiring were laid in conduits with a total length of 9½ miles. At one time 1,500 men were employed in the work.

Shortly before the plant was completed a wharf was built on the shore of Cape Fear River and a channel to it dredged from the navigable part in order that supplies required for the operation of the plant could be delivered by boat. A 140-ton vessel propelled by a 100-h.p. Diesel engine was acquired for this purpose, and equipped with special tanks to carry sulphuric acid.

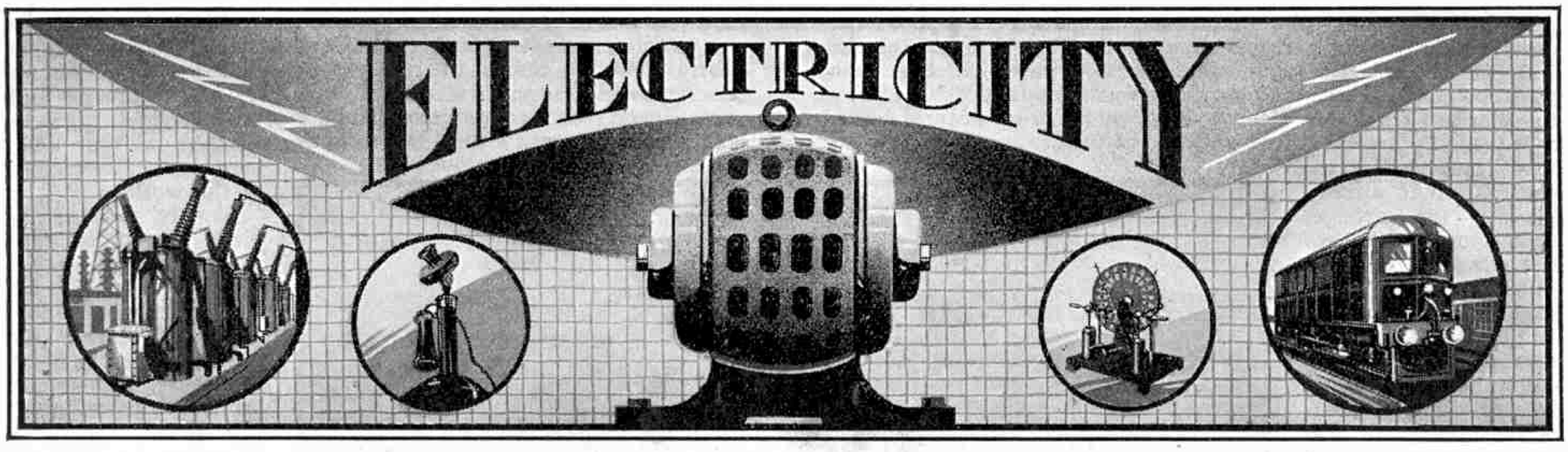
The design of the intake for the water to be treated had to be carefully thought out, for no structure of this kind had ever previously been planned. Experience with the pilot plant showed that a single row of piles would not withstand the pounding of the ocean waves, and it was therefore decided to protect the channel on each side by two parallel rows of piling made rigid by means of cross pieces. Interlocking sheet steel piles 50 ft. in length formed the intake walls, and these were driven to a depth of about 42 ft. below low tide level. Lines of similar piles constituted the supporting cross pieces, and the spaces between the walls were filled with sand dug out of the channel itself.

The intake constructed in this manner is about 200 ft. long, and extends 30 ft. into the ocean at low tide and about the same distance on to the land at high tide. The channel between its double walls is 15 ft. wide, and water rushing up it flows into a great settling basin, 112 ft. long, 76 ft. wide and 12 ft. deep, that has walls formed of similar piles and strengthened by steel rods anchored in timber piling to enable them to withstand side thrusts. Considerable difficulty was experienced in driving some of the piles, and jets of water at a pressure of 100 lb. per sq. in. therefore were used to clear away the sand below them as they were hammered into position.

The water from the settling basin flows into concrete compartments provided with bulkheads and screens to remove floating sticks and other foreign materials, and is then pumped into pipes, one of which has a diameter of 6 ft., that deliver it to a reservoir from which it can be passed on the plant as required. The works are on the bank of the river and sea water from the reservoir reaches them by means of a canal 4,000 ft. long and 6 ft. in depth.

An interesting proof of the care with which every detail has been thought out is the provision of a pond through which the sea water is by-passed during summer. This has a large surface area and during several months of the year the temperature of the water passing through it is raised high enough to increase the efficiency of the plant to an appreciable extent.

Two units for the extraction of bromine have been erected near the shore of Cape Fear River, and between *(Continued on page 132)*



GIANT X-RAY TUBES FOR HEALING PURPOSES

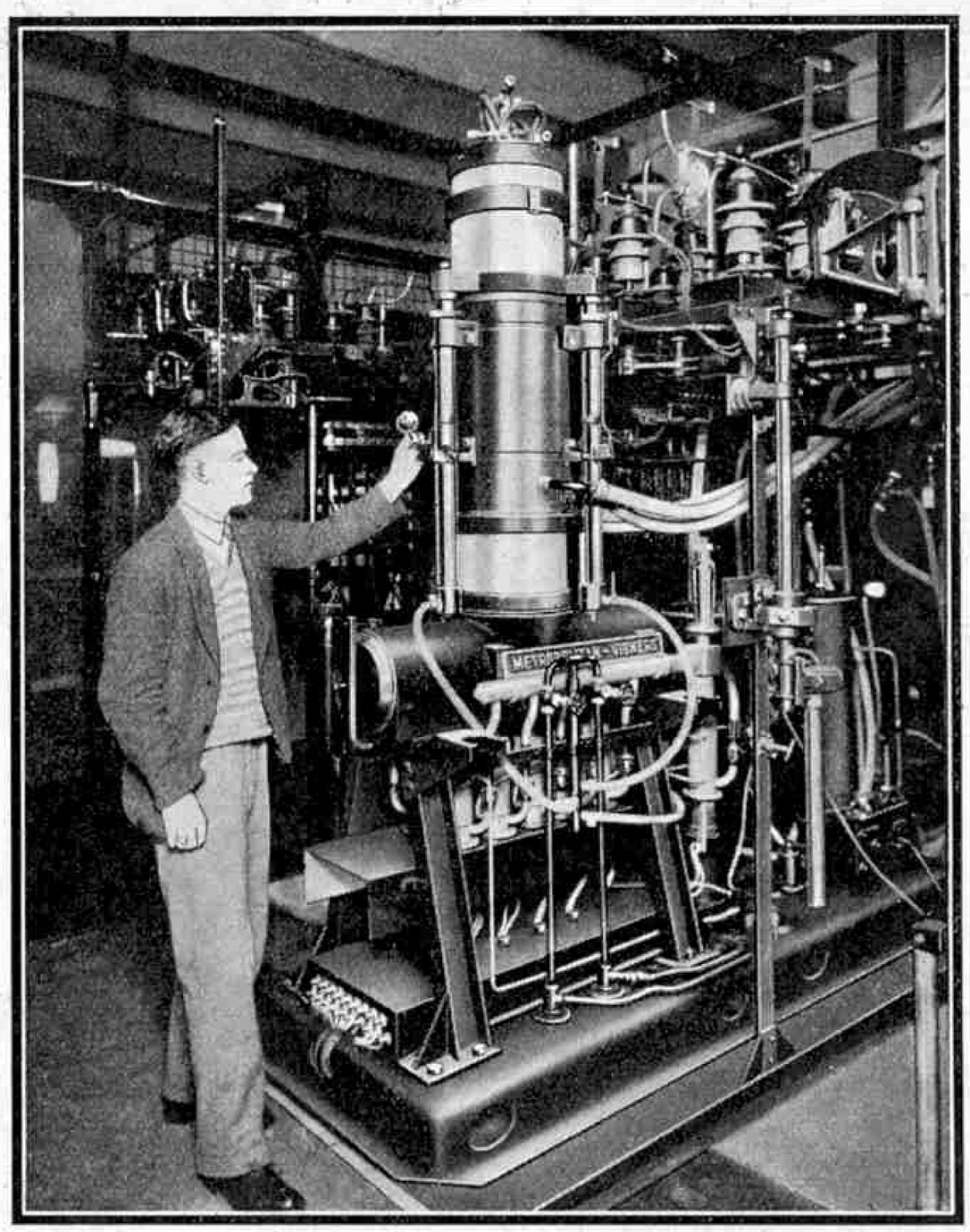
MANY of the scientific triumphs of recent years may be said to have originated from nothing, or rather from the nearest approach to nothing that could be achieved! This statement sounds absurd until it is realised that the X-ray tube, the wireless valve, the photo-electric cell and similar devices depend for their working upon the production of what is called a vacuum. A vacuum of course should be empty space, but this ideal state is never reached, for there are millions of molecules in every so-called vacuum tube yet produced. The name is convenient, however, and is retained because the number of these tiny particles remaining in such a tube is very small indeed in comparison with the number that would be present in it at atmospheric pressure. For instance, a glass bulb 5 in. in diameter filled with air at atmospheric pressure contains so many molecules of nitrogen, oxygen and the other constituents of the atmosphere that their number would have to be represented by the figure 29 followed by no fewer than 21 ciphers. This is several million million million times the number present after evacuation to the utmost limit attainable, but even then there are in the bulb sufficient to require the number 37 followed by 12 ciphers to enumerate them.

The air removed from a vacuum tube of the usual type is pumped out and the vessel is then sealed off, the necessary electrodes being introduced before the evacuation and the sealing takes place. Unfortunately a vacuum formed in this manner cannot be relied upon, for gas lurks in unsuspected quarters and later makes its appearance in the tube, which loses its efficiency for its special purpose. The chief source of this gas is the glass of the tube, and even prolonged baking before the final sealing is not sufficient to prevent gas discharges. It is therefore very difficult to render a tube completely free from gas, and to enable the desired low pressure to be maintained in it, for the gas that continually diffuses from the glass can only be removed by the action of metallic vapour leaving the electrodes themselves, and this is not sufficiently effective.

The trouble is intensified when high voltages are used, for their rapid application leads to harmful gas discharges, which may be so severe that the glass wall of the tube may be fractured, involving costly replacement. The failure of an electrode or of any other part of the complicated glass tubes now used also renders the tubes useless, unless extensive repairs are carried out, and because of these difficulties it was recognised that a type of vacuum tube that could easily be dismantled and from which the gas is removed continuously during action would be a great advantage. Tubes of this kind have now been developed, and these have the added advantages that they are constructed on what may be described as sound engineering principles and the use of glass is avoided. This means longer life and greater utility, for higher voltages can be used with safety.

The event that led to the introduction of the new types of vacuum tubes was the unexpected discovery of oils and greases with very low vapour pressures. The experiments that led to the production of those oils had no connection with work on vacuum tubes, and indeed were not expected to have any industrial applications. They were carried out in the research laboratories of the Metropolitan Vickers Electrical Company Ltd., where certain oil distillates were produced that boil without decomposition, and have a rate of evaporation at room temperature that is so small as to be almost unmeasurable. It was realised at once that the oils were ideal working liquids for pumps intended to extract the air from vacuum tubes and to-day large and highly efficient X-ray tubes, wireless valves, vacuum furnaces and alternating current rectifiers are built in which the parts can readily be dismantled, and put together again, because they incorporate oil pumps that remove the air in a very short time and act continuously while the vacuum tube itself is in operation.

How valuable this discovery is can be realised from a description of the X-ray tubes in which it is applied. Many important uses are made of X-rays, but none is of greater interest than their application to the cure of cancer and other diseases. For this purpose very penetrating radiation that can only be obtained by the use of very high voltages is required. The continuously evacuated X-ray apparatus developed by the Metropolitan-Vickers Electrical Company Ltd. therefore is designed to have a continuous rating of 250,000 volts, which at present represents about the maximum that radiologists require. Actually it is designed to withstand pressures of 300,000 volts and the internal clearances were so chosen that sparkovers do not occur with even higher pressures.

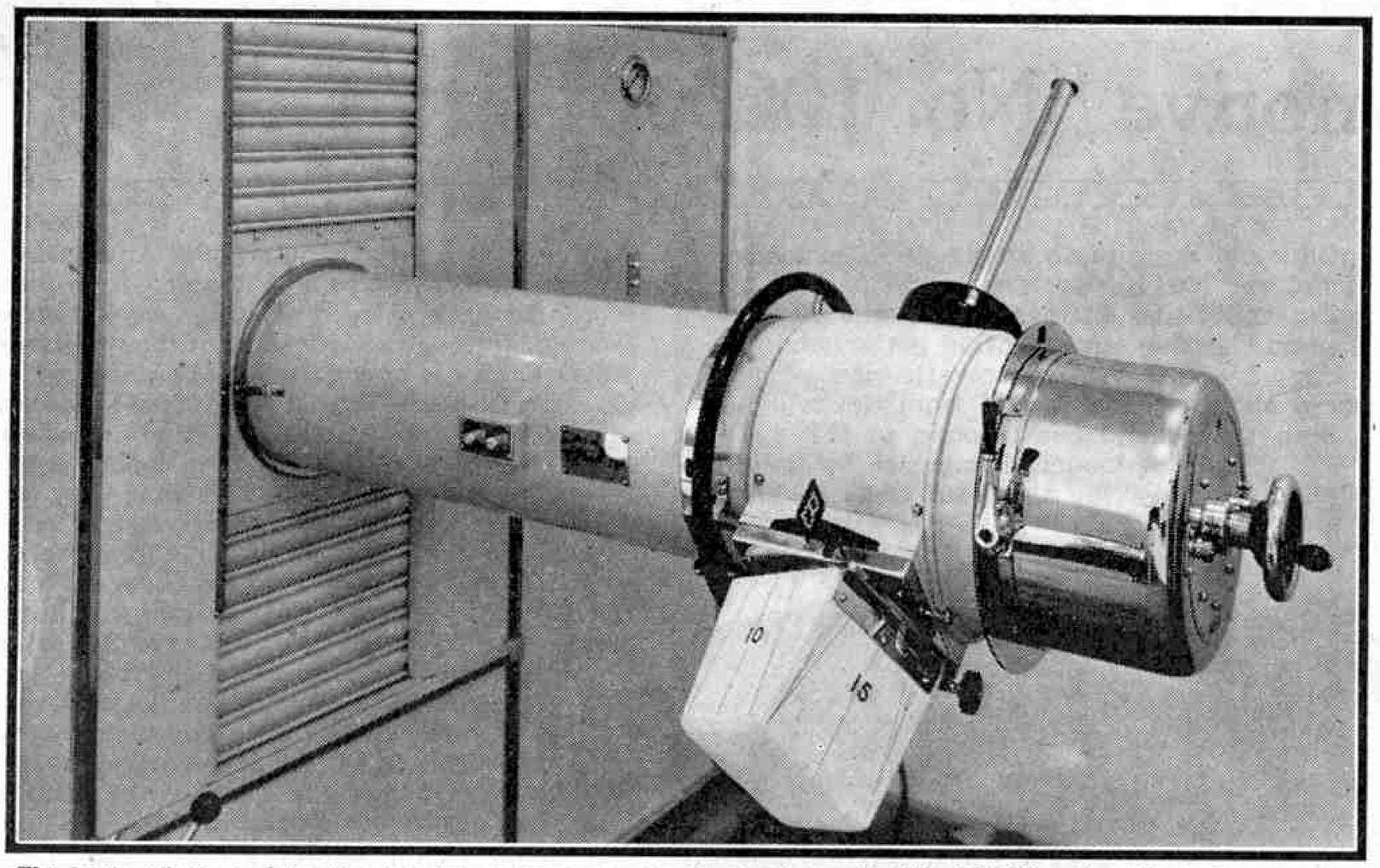


The 500 kW continuously evacuated valve at Rugby Wireless Station. This is the largest valve in the world, and an ordinary receiving valve is being held near it to show its comparative size. We are indebted to the Metropolitan-Vickers Electrical Company Ltd. for the illustrations to this article.

The tube is so constructed that the distance between the two electrodes is about 1 in. and is the smallest gap in the tube. These electrodes of course are the cathode, from which a stream of electrons is driven by the pressure of 250,000 volts applied to the tube, to strike the anode, or positive electrode, with a speed of about 100,000 miles per sec. It is the tremendous impact of this stream of electrons that generates the X-rays.

On the opposite page is a drawing showing the construction of a continuously evacuated X-ray tube of this kind. The body of the tube is of solid drawn steel and is 8 in. in diameter, the metal being

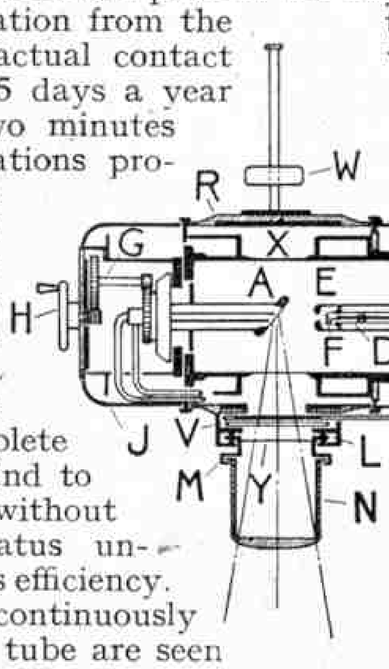
$\frac{1}{4}$ in. thick. At its ends are steel flanges with flat surfaces ground to an accuracy of one 25,000th part of an inch, and on one of these flanges is fitted a porcelain insulating sleeve 1 that supports the cathode plate C from which projects the long tube carrying the cathode itself. This consists of a small spiral of tungsten wire F housed in a small recess. Opposite to it is the anode A, the target of the electrons it gives out. This is a thin disc of gold, and as the bombardment to which it is subjected makes it very hot, it is soldered into a block of copper that is continucusly cooled by means of a stream of water from a high pressure supply. The face of the gold disc is set at an angle to the line of the tube, so that the X-rays shot out from it pass through a thinner section of the steel tube to a port or opening that directs them towards the place where they are applied.



The treatment room of the Holt Radium Institute, Manchester, showing part of the 250,000-volt continuously evacuated X-ray tube installed in it. The steel panelling seen on the left shuts off the rest of the tube.

The body of the X-ray tube has a lining of lead, $\frac{1}{4}$ in. in thickness, so that no X-rays can escape from it except through the special port provided. Protection of this kind is very important. The rays are capable of producing burns on the skin and of developing dangerous diseases that in the early days of X-ray treatment caused serious trouble, in some cases leading to the deaths of those who worked continuously with the X-rays.

In the Metropolitan-Vickers continuously evacuated tube the more dangerous rays are cut out of the beam by means of thin sheets of copper or aluminium slipped into the filter slide K, and only rays of the length required for curative action therefore reach the patient under treatment. The rays also pass through the steel tube, at this point only 1 m.m., or .0394 in. in thickness, and this helps to filter out undesirable radiation. In addition a thick sheet of lead can be placed in the path of the rays. This has the effect of stopping all radiation from the tube, and it is then safe to remain in actual contact with the tube eight hours a day for 365 days a year without harmful effects, although two minutes at short range exposure to the radiations produced by the tube would cause severe burns. The robust design made possible by the new principle applied in the construction of the tube enables complete protection of this kind to be given easily without making the apparatus unwieldy or lowering its efficiency.



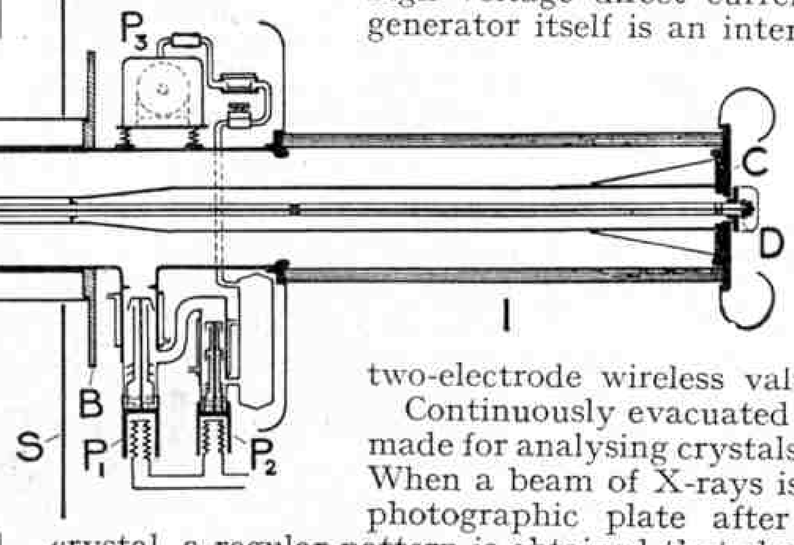
Sectional drawing of the 250,000-volt continuously evacuated X-ray tube.

The pumps that continuously evacuate the X-ray tube are seen at P1 and P2. They are automatic in operation, and remove so much air that the pressure within the tube is about one million million millionth of that of the atmosphere. This extremely low pressure is readily maintained and even after prolonged use there is no deterioration of the vacuum to impair the value of the tube.

It is interesting to realise how much of the energy applied to X-ray tubes is wasted. Very few of the electrons that shoot across the gap between the filament and the anode target make direct collision with the atoms of gold against which they are directed. Most of them are simply deflected and lose all their energy in a series of what may be called half-hearted collisions. These contribute nothing to the X-ray beam, which is produced only by direct hits, and it has been estimated that at 250,000 volts the Metropolitan-Vickers tube has an efficiency of less than one per cent., generating not more than 30 watts of radiation. Even this does not complete the story of unavoidable waste, for much of the radiation is absorbed in the walls of the tube, and 90 per cent. of the beam that does leave the tube is taken up in the thin sheets of copper or aluminium that filter out dangerous radiations. The result is that at 40 cm., or 1 ft. 4 in. from the target, a distance commonly used for treatment, the intensity of the energy of the X-ray beam is only 30 microwatts per sq. cm., a microwatt being one-thousandth of a watt. How great is the need for protection is shown by the fact that even this beam would have a dangerous effect on the skin of the operator if he were exposed to it for only six minutes.

Special precautions are taken when using an X-ray tube to ensure that the radiations from it, carefully selected by means of metal filters, reach only the place where they are required for curative purposes. The patient is in a special room into which the anode end of the X-ray tube projects through a steel panel, and as this end of the tube is earthed, there is no risk of electric shock. The position occupied by the panel is shown at S in the diagram, and the upper illustration on this page shows one end of the 250,000 volt continuously evacuated tube at the Holt Radium Institute, Manchester, projecting from its supporting panel. The height of the tube can readily be adjusted, and the anode target and the port through which the X-rays stream can be rotated to enable the rays to be directed as required.

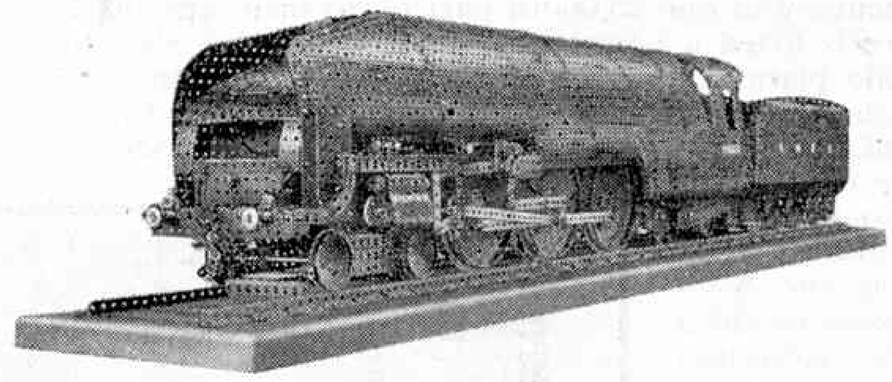
The rays from high voltage tubes are very penetrating, and are used for treating ulcers and other growths below the surface of the body. They are applied in carefully regulated doses and are completely under the control of the operator, who sits at a desk outside the room itself, and observes his patient through a window of glass that contains lead and is proof against X-rays. His desk is provided with switches and control wheels, and indicators show him how the tube and the generator that produces the high voltage direct current are working. The generator itself is an interesting application of the continuous evacuation principle, for the alternating current supplied to it is converted to the required direct current by means of thermionic rectifiers, which in effect are two-electrode wireless valves.



Continuously evacuated X-ray tubes are also made for analysing crystals of metals and alloys. When a beam of X-rays is allowed to fall on a photographic plate after passing through a crystal, a regular pattern is obtained that shows how the atoms of the elements in the crystal are distributed and gives useful information to those who work with these materials. The tubes designed for this purpose are readily dismantled and reassembled, so that there is no difficulty in renewing a filament, or changing a target, if the necessity arises, and are so simple to control that highly skilled attention is unnecessary when they are being used.

A particularly important application of the continuous evacuation principle is in the design of high power wireless valves in which no glass is used. The 500 k.w. valve illustrated opposite is of this type and is the largest in the world. It stands 10 ft. in height and weighs more than a ton! In the main transmitter at Rugby it has taken over the task previously performed by a bank of 50 high power valves. Its filament is made in no fewer than nine sections, through which passes a current of about 500 amps, or about 5,000 times that of an ordinary receiving valve.

1 in. Scale Meccano Model of L.N.E.R. High-Pressure Locomotive "No. 10000"



IN this article we continue our description of the Meccano model of the L.N.E.R. locomotive "No. 10000."

Last month the boiler and boiler fittings of the model were described. The next section claiming our attention is the chimney and smoke-deflector, Figs. 1 and 2. An underneath view of the deflector is shown in Fig. 1, and from this will be seen the general construction of this part of the model. Commence by building the front girder, which

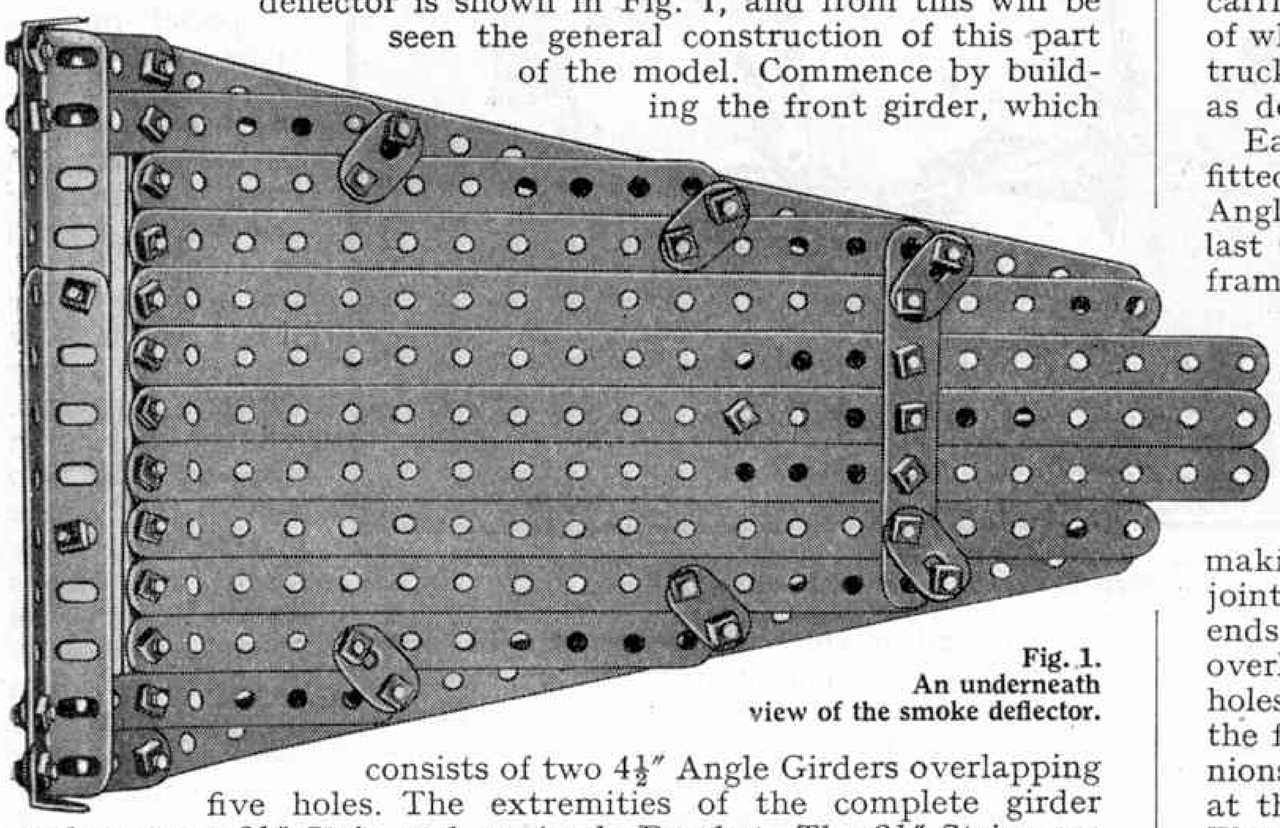


Fig. 1. An underneath view of the smoke deflector.

consists of two $4\frac{1}{2}''$ Angle Girders overlapping five holes. The extremities of the complete girder each carry a $2\frac{1}{2}''$ Strip and an Angle Bracket. The $2\frac{1}{2}''$ Strips are fitted with $9\frac{1}{2}''$ Strips at their free ends, and these form the outer edges of the deflector. The outer ends of the $9\frac{1}{2}''$ Strips are drawn together until they are 3" apart, and the triangular space so enclosed is filled in as shown in the illustration. The oblong space remaining near the bottom of the deflector is used in actual practice as a trap for air, feeding the fire, and is fitted with a shutter that controls the volume of air passing through it. This system allows an adequate amount of hot air to be delivered to the fire-box under all conditions.

When the deflector is built up it must be curved to the correct shape, for which purpose the front of the already shaped boiler must be constantly referred to. When bent it is held in place at its lower end by the Angle Brackets shown in Fig. 1, and at its upper end it is attached to the boiler by the ends of the three centre Strips. The position of the Angle Brackets will be found on reference to Fig. 1 of last month's article.

The chimney is constructed in the following manner. A $2\frac{1}{2}''$ Flat Girder is bent round the periphery of a 1" loose Pulley, and at each end is fitted with two $2\frac{1}{2}''$ Strips, the four being connected together by a $\frac{3}{8}''$ Bolt in order to give the desired tapered effect. Two $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Brackets are now fitted, and these carry two $1\frac{1}{2}''$ Strips, the end holes of which are connected together by a $\frac{3}{4}''$ Bolt, which passes into the top of the smoke-deflector when the chimney is placed in position. The top of the chimney consists of a 1" loose Pulley held in place by means of a 6 B.A. Bolt, the shank of which passes through the slotted hole of a $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Bracket attached to the chimney. The complete chimney is attached to the deflector by the $\frac{3}{4}''$ Bolt already mentioned, and also by an Angle Bracket, part of which is shown in Fig. 2.

Building the Main Frames

Fig. 5 shows the construction of one side of the main frames, and from this it will be seen that two $24\frac{1}{2}''$ Angle Girders, overlapping 12 holes, form a base on which is constructed the remainder of the main frame, and also the bearings for the wheel axles. The part of the frame that carries the driving wheel axles is strengthened by fitting five $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates and one $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate. Each Plate overlaps its neighbour one hole, with the exception of that at the rear end of the strengthened portion. The upper edges of these plates are coupled together by a girder consisting of one 3" Angle Girder overlapping an $18\frac{1}{2}''$ Angle Girder two holes, and this latter in turn overlaps a $9\frac{1}{2}''$ Angle Girder four holes. The front end of the frame is fitted with a $2\frac{1}{2}''$ Angle Girder, which will be used later for joining the two sides of the main frame together. An $18\frac{1}{2}''$ Angle Girder is now fitted to the near end of the frames and this carries a Boss Bell Crank, which is used for supporting the rear pair of wheels. In the actual engine these wheels are carried on a Bissel truck, but in the demonstration model it is advisable to fit them as described owing to the fact that they are raised off the rails.

Each side of the front bogie is constructed from a $7\frac{1}{2}''$ Flat Girder fitted with a $7\frac{1}{2}''$ Angle Girder and attached, by means of a $3\frac{1}{2}''$ Angle Girder and two Flat Brackets, to a $4\frac{1}{2}''$ Angle Girder. This last Girder is secured by two Bolts to the underside of the main frame, and $2\frac{1}{2}''$ large radius Curved Strips are fitted to the bogie as shown, so that the main frame appears to be cut away in order to accommodate the bogie wheels. When the two frame sides have been completed they are joined together by bolting a $7\frac{1}{2}''$ Angle Girder, carrying the buffer beam and buffers, across the front of the frames. The Girder is held in place by means of two $1'' \times 1''$ Angle Brackets, and the two ends of the Girder overhang the frames three holes, thus making the frames $4\frac{1}{2}''$ wide. The lower edges of the bogie are jointed together by two $4\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips. The rear ends of the frames are coupled together by two $4\frac{1}{2}''$ Angle Girders overlapping each other five holes and overhanging the frames two holes on each side. Three intermediate struts are fitted between the frames and these consist of $4\frac{1}{2}''$ Angle Girders bolted to Trunnions. A $4\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate is secured between the Angle Girder at the front of the model, and above this is carried two $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates shown in Fig. 6.

The front footplates are now fitted, and consist of two $2\frac{1}{2}''$ Angle Girders, one of which is shown in Fig. 5. A 2" Angle Girder situated to the side of this, but running parallel to it, is bolted in the end hole of the Girder forming the buffer beam and is connected by a 3" Curved Strip and a 3" Strip to two $7\frac{1}{2}''$ Angle Girders representing the side of the footplating. These are extended at their rear end for a distance of 1" by two 2" Angle Girders, and the complete girder carries one $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate and one $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate. The latter Plate overlaps the $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate one hole. Each support for the rocking links of the valve gear consists of two Girder Brackets joined together at right angles by a $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Bracket. The whole is connected to the main frames by a $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Bracket and a $2\frac{1}{2}''$ Flat Girder. A 1" Triangular Plate is bolted to the extremity of each outside Girder Bracket.

Each side of the rear of the main frame is shaped from Flat Girders of varying lengths secured to a $12\frac{1}{2}''$ Angle Girder attached at one end to the main inner Girder by a $1'' \times 1''$ Angle Bracket. The other end of this Girder is bolted to the outer extremity of one of the $4\frac{1}{2}''$ Angle Girders mentioned earlier. The cab steps, built up from $2\frac{1}{2}''$ Flat Girders bolted to $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips, are fitted

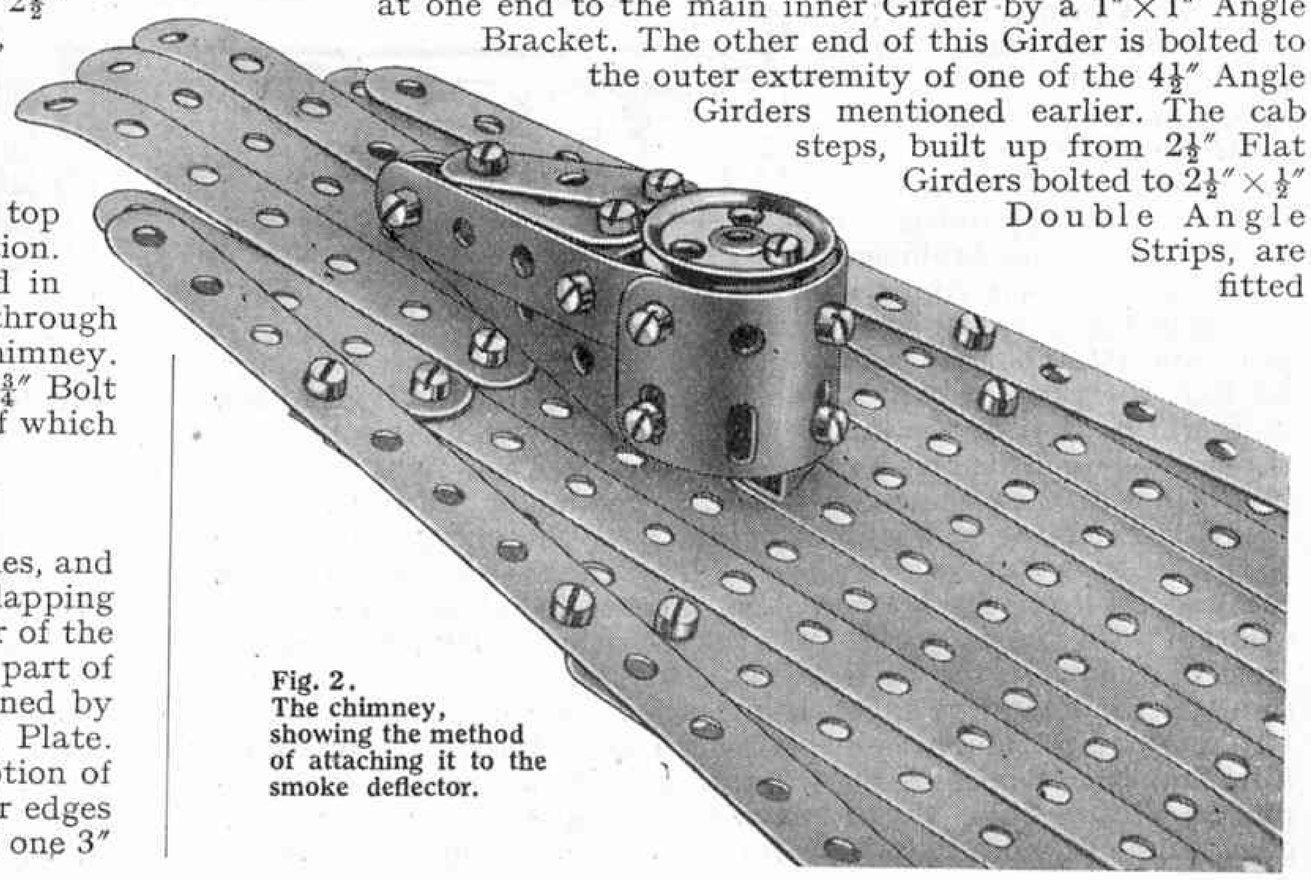


Fig. 2. The chimney, showing the method of attaching it to the smoke deflector.

to the rear of the main frames as shown in the illustration.

The front bogie wheels consist of Face Plates on each of which is mounted a Wheel Flange. The axles, 5″ Rods, are journalled in Double Arm Cranks bolted to the top of the 7½″ Flat Girders forming the bogie sides. The front axle carries a 1″ Sprocket Wheel and the second axle carries two Sprockets of a similar size. One of the two latter Sprockets is connected by Sprocket Chain to the Sprocket on the front axle. The two front wheels are protected by guards made from ½″ Reversed Angle Brackets. Each of the main driving wheels is constructed from a Circular Plate and a Hub Disc, a Bush Wheel being bolted in the centre of the wheel so formed, to enable it to be secured to an Axle Rod. A Double Arm Crank is also fitted to each wheel in the position shown in Fig. 6. The Wheels are mounted on 5″ Axle Rods journalled in Double Arm Cranks and the three Wheels on one side of the locomotive have their cranks set at an angle of 90 degrees to those of the other side.

The Double Arm Cranks on the front and rear wheels are connected to those on the centre wheels by means of 7½″ Strips, the Strips being so arranged that they overlap each other three holes at the point where they are fitted to the centre wheels. Pivot Bolts are used for attaching the Strips to the front and rear wheels, and 1″ Rods are used where they are connected in the centre. The 1″ Rods each carry a Crank, termed the return crank, so arranged that it moves a little in advance of the crank pin when the locomotive is travelling forward. The front and rear 5″ Rods each carry two 2″ Sprocket Wheels. One of each of these is used for connecting the front and rear set of driving wheels together; the remaining two connect the driving wheels with the 1″ Sprockets on the bogie axles.

The front pair of wheels, of what appears to be a rear bogie, is carried on a 6½″ Rod journalled in Double Arm Cranks. These Cranks are partially hidden by axle-boxes, each of which is constructed from two 1″×½″ Angle Brackets bolted to laminated springs by a ⅜″ Bolt. This Bolt also carries a Hinge fitted with a Flat Bracket forming the axle-box flap. Each laminated spring is built up from two 4½″, 3½″, 2½″ and 1½″ Strips, and the whole is carried on two ¾″ Bolts supported by two Handrail Supports.

Each cylinder is built up in the following way, and care must be taken to see that a right-hand and a left-hand cylinder are constructed, and not two for the same side. Two Sleeve Pieces, using ½″ Bolts with their shanks outward, are bolted by their centre holes to the end slotted holes of a 2½″ Angle Girder, and matters are so arranged that these fall on the inside of the Girder. Five 4½″ Strips are now curved to the shape shown in Fig. 6, and bolted by means of Set-Screws to the 2½″ Angle Girder, a 2½″ Strip being used for spacing purposes beneath the heads of the set-screws. The simplest way of bending the Strips is to press each one separately round the circumference of a wooden roller 1½″ in diameter, a bend being made in the last hole but one in the opposite direction to the curve. The free ends of the Strips are connected together by a 2½″×½″ Double Angle Strip, a second Double Angle Strip being used in the centre of the Strips.

These two Double Angle Strips carry two 1½″ Pulley Wheels that form the end of the cylinder. A third 2½″×½″ Double Angle Strip is used to form a connection between these Pulleys and the Sleeve Pieces forming the valve chest. Drain cock pipes are fitted to the underside of the cylinders, and these are constructed similarly to the handrails on the boiler. The cylinders, when completed, are each secured to the main frames by locking the ½″ Bolts protruding from the top of the steam chest to the outer holes of two 1½″×½″ Double Angle Strips. These Double Angle Strips are bolted between the outer Girder of the footplating and the main frames. A further support is formed for the cylinder by substituting two of the Bolts securing the free ends of the Strips of the cylinder for two ¾″ Bolts. The ends of these are passed through suitable holes in the main frame and are locked in position by two nuts.

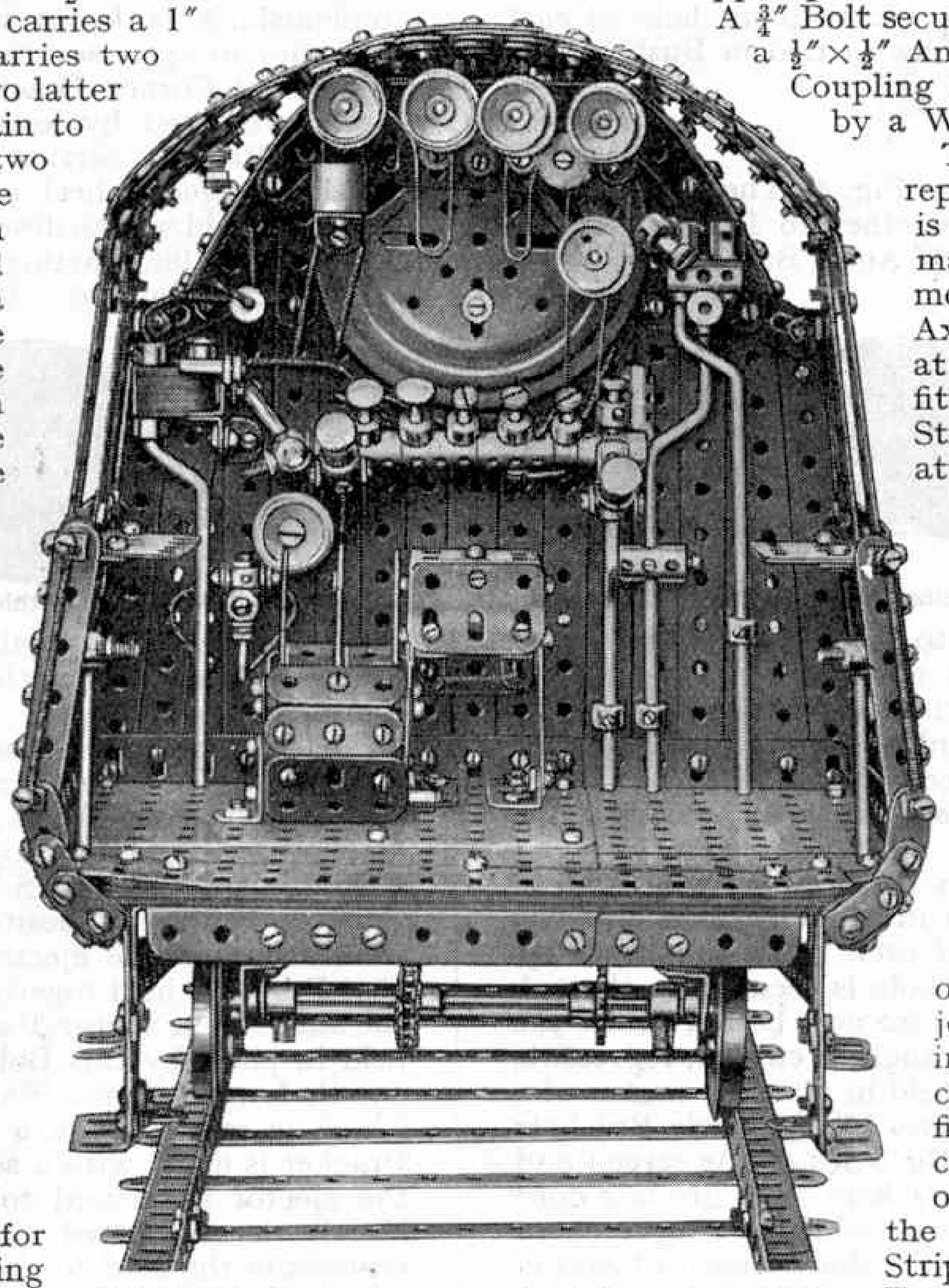


Fig. 3. This illustration shows the boiler end complete with its various fittings.

A ½″×½″ Angle Bracket secures the slide bar, Fig. 6, to its cylinder. This consists of two 5½″ Strips spaced apart at each end by one Washer, and the lower strip carries an Eye Piece, the overlapped portions of which slide between the two Strips. A ¾″ Bolt secured in the boss of the Eye Piece carries a ½″×½″ Angle Bracket and a Strip Coupling, the Coupling being spaced from the Angle Bracket by a Washer.

The valve gear, which is an accurate reproduction of Walschaerts valve motion, is now proceeded with in the following manner. The Strip Coupling already mentioned carries the piston rod, a 3½″ Axle Rod, in its drilled hole, and the slot at the opposite end of the Coupling is fitted with one end of a 9½″ Strip. This Strip forms the connecting Rod, and it is attached to the wheels by passing its free end over the 1″ Rod that is carried in the boss of the Double Arm Crank bolted to the centre driving wheel.

The return crank, the position of which has already been described, is secured to the 1″ Rod on the outside of the connecting Rod. The Angle Bracket secured to the Strip Coupling has a 2″ Strip pivotally attached to it, and this Strip in turn carries a 3″ Strip. This latter Strip is secured by its next to top hole to a Collar, a Set-Screw being used for this purpose in place of a Bolt. The Collar is carried on the side valve Rod, a 3½″ Rod, that is journalled in Chimney Adaptors carried in the Sleeve Pieces forming the steam chest. The top hole of the 3″ Strip is fitted with a pivotally mounted Strip composed of one 3″ and one 3½″ Strip overlapping two holes. The free end of the Strip is carried, together with a 1½″ Strip, on a ½″ Bolt clamped in the boss of an Eye Piece. This Eye Piece slides almost vertically on the reversing link that is built up from two 2½″ large radius Curved Strips spaced apart at each end by means of two Washers.

The outside Strip of the link is carried on a lock-nutted bolt secured to the Triangular Plate the fitting of which has already been described. The lower securing Bolt of the link carries a Flat Bracket, and this is connected by two 3½″ Strips, overlapping two holes, to the return crank on the centre driving wheel. The top hole of the 1½″ Strip, attach to the reversing link, is attached by a Bolt and lock-nuts to a 2½″ Strip that is bolted to a Crank, thus forming a lever 2½″ long. The Crank is mounted on a 6½″ Rod, journalled in Handrail Supports, that runs transversely across the main frames; thus a connection is formed between the two reversing links of the valve motion. The Rod also carries a Crank fitted with an End Bearing, and this will be connected later to a lever in the cab.

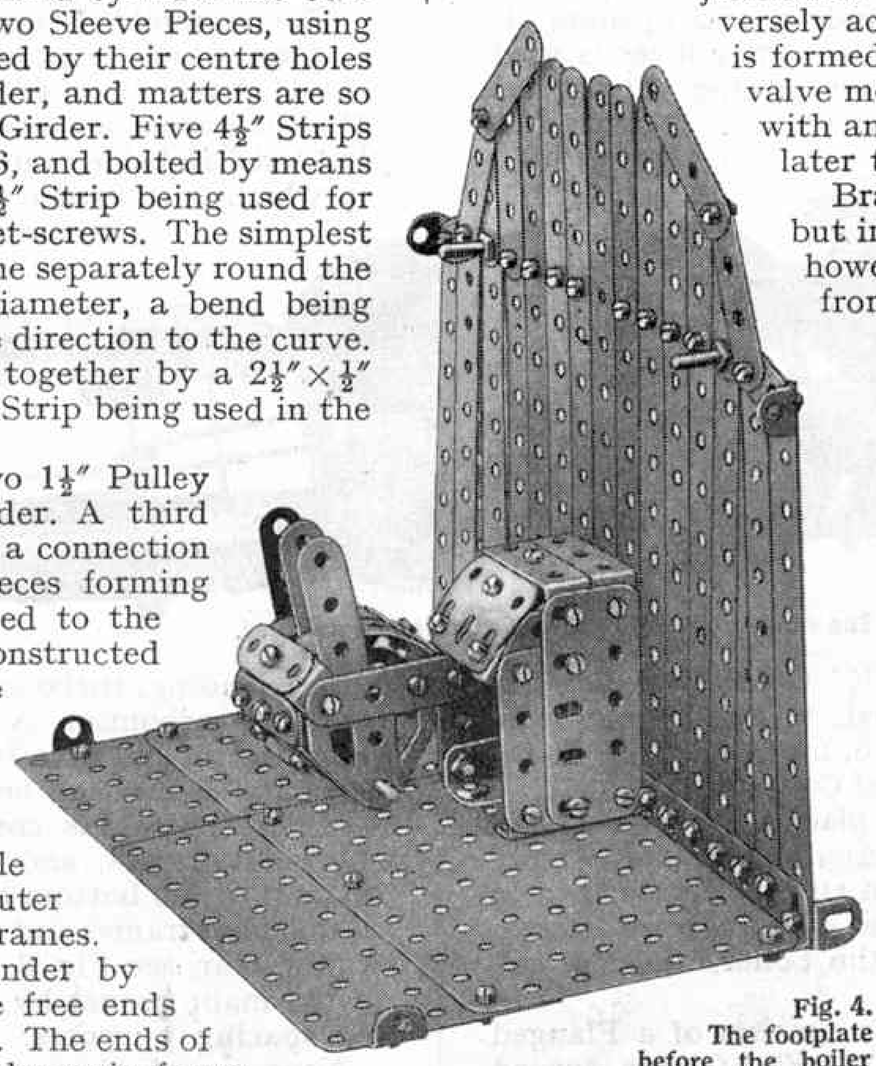


Fig. 4. The footplate before the boiler fittings, etc., have been added.

Brakes are fitted to all six driving wheels, but in the model they do not work. They may, however, be coupled together, and operated from a lever in the cab. The brakes on the front and centre driving wheels consist of 3½″ Strips, fitted with Flat Brackets, carried on ¾″ Bolts. Those on the rear wheels consists of 2½″ Strips, fitted with Flat Brackets, and carried on ½″×½″ Angle Brackets. Sand pipes, constructed on similar lines to the handrails on the boiler, are fitted to the front and centre driving wheels.

When the main frames have been completed the supports for raising them above the level of the rails are fitted. At the front end the support is formed from two 4½″ Angle Girders (see Fig. 1 of last month's article). These two Girders are bolted together to form a reversed angle girder, and are attached to the main frames by means of the foremost 4½″×½″ Double Angle Strip of the bogie. The remaining 4½″×½″ Double Angle Strip of the bogie is fitted with two Double Arm Cranks carrying 1″ Rods, the lower ends of which rest in Bush Wheels

screwed to the board of the model. The supports at the rear of the main frames consist of Couplings secured by means of two Bolts each to the cab steps. The steps are prevented from distorting under the weight of the engine by securing a Rod between the two Couplings, this Rod being held in the centre plain hole of each Coupling. The lower ends of the Rods are carried in Bush Wheels as before.

Constructing and fitting the Cab

The framework of the cab is shown in Fig. 4. The floor consists of four $5\frac{1}{2}'' \times 3\frac{1}{2}''$ Flat Plates bolted together to form an oblong $8\frac{1}{2}''$ in length and 5″ in width. Two $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Brackets and two $4\frac{1}{2}''$ Angle Girders, overlapping one hole, are fitted to the front end of this platform, the $4\frac{1}{2}''$ Girders being used for carrying the front wall of the cab. This wall is built up from seven $7\frac{1}{2}''$ Strips, shorter Strips being used at each side in order to obtain the desired shape as shown in the illustration. When all the Strips are in place, a $5\frac{1}{2}''$ Strip is bolted horizontally across the back of the wall and 10 of the Strips are bolted to this, the centre one not being secured until the end of the boiler is in place. The four $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Brackets are now fitted; these are used later for securing the complete cab in place.

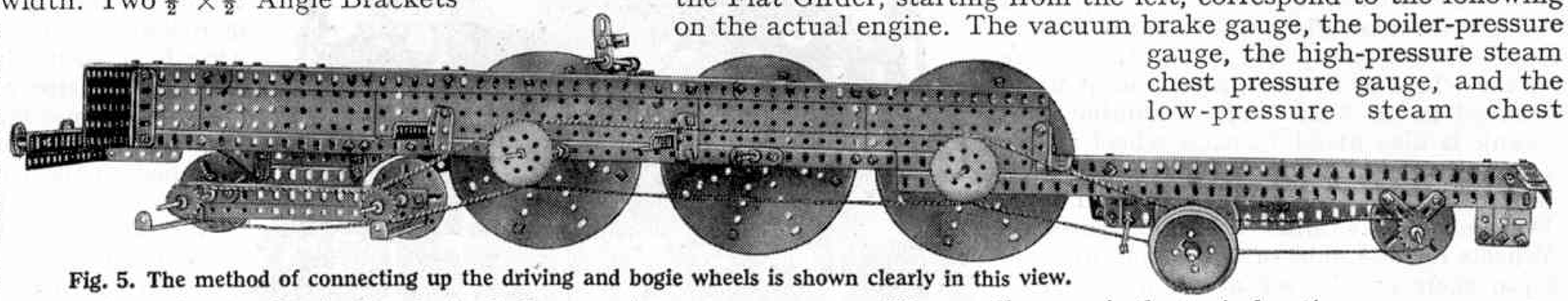


Fig. 5. The method of connecting up the driving and bogie wheels is shown clearly in this view.

The fire-box door screen is built up from two $2\frac{1}{2}''$ and two 2″ Flat Girders, joined together as shown in order to form the two sides of the screen. The bottom end of each is fitted with a $1\frac{1}{2}''$ Angle Girder by means of which the whole is secured to the cab floor. Two $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips are now bolted across the top of the screen and a $1\frac{1}{2}''$ Flat Girder, slightly curved, represents the glare deflector. This Flat Girder is held in place by means of a Flat Bracket at its upper edge and by two $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Brackets at its lower edge. The spaces between the sides of the screen and the deflector are filled in by the Flat Brackets. The fire-box door consists of a $1\frac{1}{2}''$ Flat Girder, the hinges of which are represented by two Flat Brackets and the lift bar by a short length of Spring Cord. Part of the door is shown in Fig. 3.

The lever frame is built up in the following manner. The sides consist of Flat Trunnions joined together at each upper corner by a $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip. A 2″ Strip is fitted to one side of the frame and a $1'' \times 1''$ Angle Bracket to the other. These two parts are used for securing the lever frame in position. The near side of the frame, shown in Fig. 4, is filled in by means of a $1\frac{1}{2}''$ Strip and a $1\frac{1}{2}''$ Flat Girder, held in place by means of Flat Brackets. The top consists of two 2″ Strips, curved to shape and clamped in position at each end by a $1\frac{1}{2}''$ Strip. The three levers, two of which are dummy, are carried on a 2″ Rod, Collars being used for holding them in position. In actual practice the levers, starting from the right-hand side, are used for reversing the low-pressure cylinders, reversing the high-pressure cylinders, and opening the cylinder drain cocks. On the model only the centre lever is used, this being for actuating the reversing links on the valve-gears. A Flat Bracket is attached to this lever, and a Collar, carried in the end hole of this, supports one end of a $3\frac{1}{2}''$ Crank Handle. The inner end of the Crank Handle is coupled, when the cab is in position, to the End Bearing, shown in Fig. 6, by $11\frac{1}{2}''$ and $4\frac{1}{2}''$ Rods. These Rods are joined together by means of Couplings.

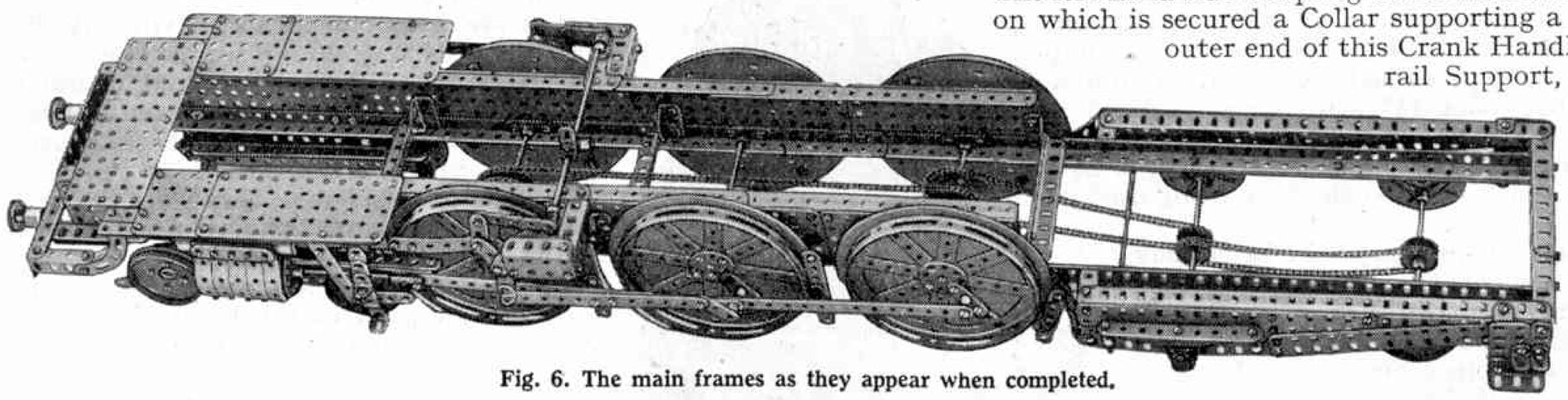


Fig. 6. The main frames as they appear when completed.

All is now ready for fitting the cab in place inside the boiler. This is accomplished by bolting the six Angle Brackets already mentioned to the inside of the cab sides in the position shown in Fig. 3. The short strips at the top of the front of the cab are altered, if necessary, to conform to the shape of the boiler, and the cab fittings are then proceeded with.

The end of the boiler is first fitted. This consists of a Flanged Disc (Part No. 168a) to which is bolted a $3\frac{1}{2}''$ Flat Girder, spaced away from the boiler end by means of three Washers. The Flat Girder is bent outward slightly at the right-hand side, and this enables the driver, in actual practice, to get a clear view of the gauges. Two large Corner Brackets shown protruding below the Flat Girder are now fitted, the left-hand one of which carries the oil replenishing tank for the telemotors. This is represented by a Chimney Adaptor secured by means of a $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Bracket to its respective Corner Bracket. The pipes leading to the telemotors are represented by lengths of Spring Cord. The right-hand side Corner Bracket carries a Threaded Pin on which is mounted a small Flanged Wheel representing the manifold pressure gauge. The manifold will be described later. The four large gauges fitted on the Flat Girder, starting from the left, correspond to the following on the actual engine. The vacuum brake gauge, the boiler-pressure gauge, the high-pressure steam chest pressure gauge, and the low-pressure steam chest pressure gauge. The small gauge is the train heating pressure gauge. The pipe-loops below the gauges consist of short lengths of 23 S.W.G. wire.

The regulator is in the top left-hand corner of the cab and it consists of a Coupling mounted on a Threaded Pin as shown in Fig. 3. The regulator handles, of which there are three, are represented by short lengths of Spring Cord, down the centres of which is passed a double length of 23 S.W.G. wire. This wire enables the Spring Cord to retain its desired shape. Below the regulator is fitted the vacuum brake ejector. The body of this is built up from 20 Flat Brackets held together by a $\frac{3}{4}''$ Bolt, the head of which carries the shank of a Spring Buffer. Two $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Brackets are also held in place by this Bolt. One of these Angle Brackets carries a handle formed from a Flat Bracket and Threaded Pin, the whole of which is mounted on a lock-nutted Bolt. The remaining Angle Bracket is fitted with a second similar Bracket by means of which the ejector is secured to the cab front. The top of a $3\frac{1}{2}''$ Crank Handle is now fitted in place as shown in the illustration, and represents the lead to the vacuum pipe connections seen between the coaches of a train.

The pressure reducing valve, shown on the right-hand side of the cab, is necessary, in the actual engine, in order to allow normal locomotive fittings to be used. In the model it is constructed from a Coupling, to which are secured two Threaded Bosses by means of $\frac{1}{2}''$ Bolts. One of these Threaded Bosses carries a $\frac{1}{2}''$ Bolt in its horizontal tapped hole, and on this is mounted a Collar carrying a Pivot Bolt, representing the control handle for the reducing valve. The under side of the Coupling carries a second similar part, which supports the top end of a $3\frac{1}{2}''$ Crank Handle carrying a Coupling half way down its length. This Crank Handle is held in place by a Collar secured to the cab front by a Collar. A 5″ Crank Handle, the top of which passes behind the reducing valve, is also fitted.

The manifold is now built and fitted. This consists of a $3\frac{1}{2}''$ Rod on which is carried three Couplings and four Collars. Two $1'' \times 1''$ Angle Brackets, through the outer end holes of which the $3\frac{1}{2}''$ Rod passes, are used for securing the manifold to the cab front. The left-hand side Coupling of the manifold carries a Threaded Pin, on which is secured a Collar supporting a $3\frac{1}{2}''$ Crank Handle. The outer end of this Crank Handle is fitted with a Hand-rail Support, and the complete unit represents the blower fitted to an actual locomotive for causing a draught over the fire. Attached to the manifold are six handles, the uses of which are as follows. Starting from the left-soot blower, steam reversing gear, whistle, mechanical lubricator steam sanding, turbo-generator, and anti-carboniser. A Coupling is secured vertically to the right-hand end of the manifold by a 1″ Threaded Rod, and this represents the connection between the reducing valve and the manifold.

When the cab is completed the boiler is ready for securing to the main frames, and this is carried out as follows. The girder, secured to the bottom of the smoke deflector, is bolted to the front of the main frames and in this way the front of the boiler is secured. At the rear, see Fig. 3, the cab floor is attached to the end girder of the main frames by three $\frac{1}{2}''$ Bolts, eight $7\frac{1}{2}''$ Strips being used for spacing purposes.

Next month the construction of the tender and track will be described.

(To be continued)

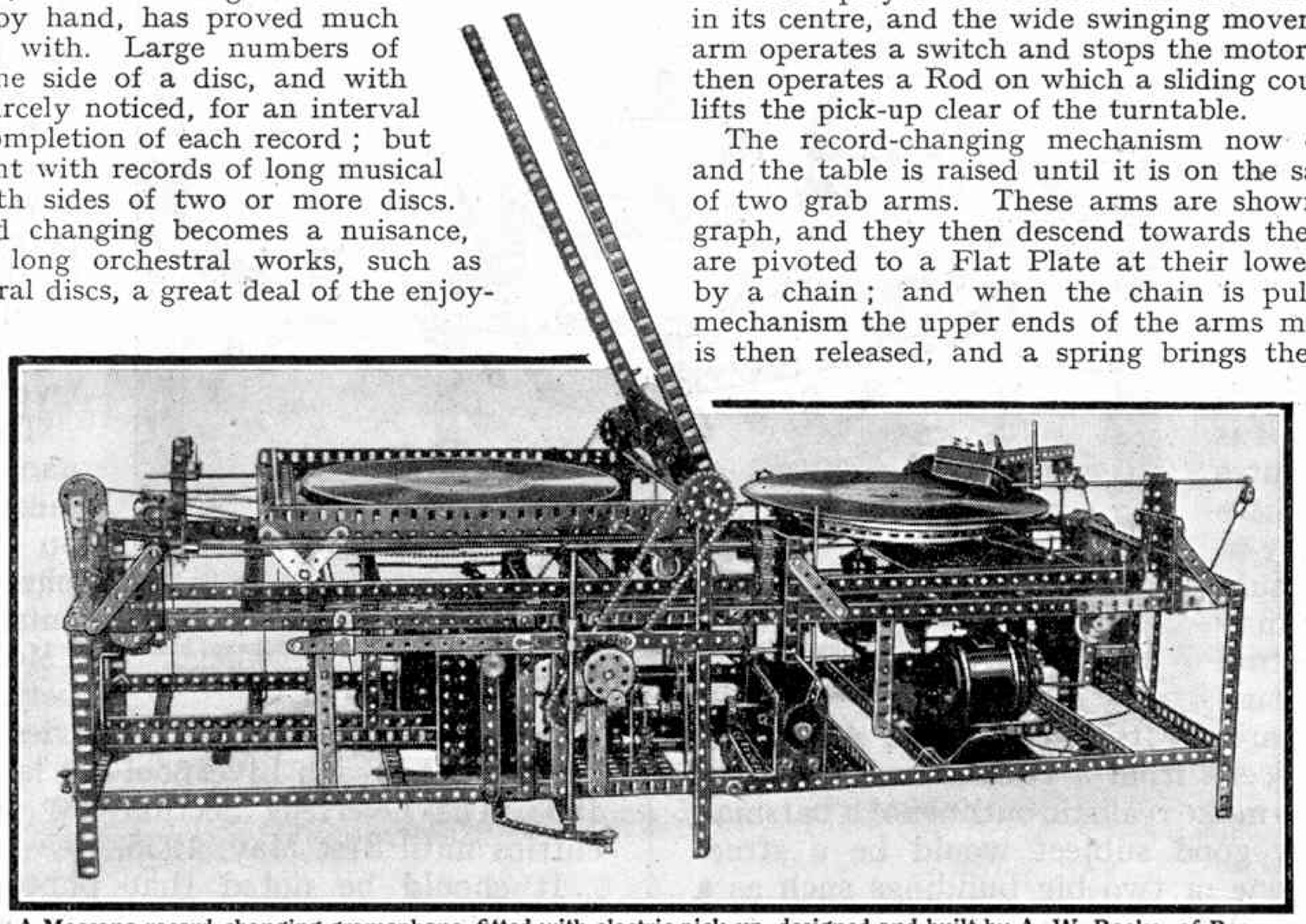
Meccano Record-Changing Gramophone

An Interesting Automatic Model

MUCH has been done during the past few years to improve the accuracy and quality of gramophone reproduction, but until comparatively recently the mechanism itself has not been made automatic in action. There has been the disagreeable necessity of having to leave one's comfortable chair every few minutes to rewind the motor, or to stop it, in order to turn over the record or substitute a fresh one. The first of these drawbacks has been overcome by the use of electric motors in place of clockwork mechanism. The motor is simply connected with the mains by means of a plug and a length of flex, and smooth and silent continuous running at unvarying speed is obtained without the least trouble, and at very little cost.

The second drawback, that of having to reverse or change the record by hand, has proved much more difficult to deal with. Large numbers of records occupy only one side of a disc, and with these the trouble is scarcely noticed, for an interval naturally follows the completion of each record ; but the case is very different with records of long musical works that occupy both sides of two or more discs. Here the reversing and changing becomes a nuisance, and with operas and long orchestral works, such as symphonies, filling several discs, a great deal of the enjoyment of the music is inevitably lost.

The mechanical difficulties of producing effective automatic changing are many, one of the greatest being that of ensuring that the records shall be absolutely protected from damage during the change. The first efficient system was produced by the Gramophone Co. Ltd., a few years ago. Since that time experts have been engaged continually on the task of simplifying and improving the mechanism, and they have now developed an apparatus that is remarkable for its efficiency and reliability.



A Meccano record-changing gramophone, fitted with electric pick-up, designed and built by A. W. Boeke, of Baarn, Holland. The model won a prize in a recent "M.M." Competition.

This mechanism brings us within sight of the perfect gramophone, but there remains the drawback that only one side of each record is played. This defect is eliminated in a large proportion of H.M.V., and more recently also Columbia, recordings of complete works occupying several discs, by means of special couplings that bring successive sections of the record into correct sequence for automatic playing.

In view of the many difficulties that have to be overcome it is particularly interesting to learn that an automatic record-changing mechanism has been built successfully from Meccano parts by A. W. Boeke, of Baarn, Holland. This keen enthusiast set out to build an all-electric gramophone from Meccano, and the results of his efforts are shown in the fine model illustrated on this page. The record-changing mechanism was designed by Boeke himself, and is not copied from any commercial design. We give here a brief account of its most important features in the hope that it may be of assistance to other model-builders who may wish to construct a similar model.

Boeke's mechanism is designed to play one side of each of five 10-in. records in succession, and then the other sides of the five. The turntable of the machine is rotated by a frictional h.p. electric motor by means of a belt drive. As each record is played through it is automatically removed from the table and replaced by another from a pile previously arranged on a carriage. The mechanism for this operation is driven by a suitably geared Meccano Electric Motor. The speed at which the turntable revolves is kept constant at about 78 r.p.m. by means of a governor, but it can be altered by turning a screw that adjusts the radius of gyration of the governor weights.

The five records to be played are placed on a carriage, which is seen on the left in the accompanying illustration. The Meccano Motor is switched on and the carriage travels slowly towards the turntable until finally it comes to rest exactly above it. Two vertical Rods, which can be seen in the illustration, close to the side of the turntable, then rise until their tops are level with the upper surface of the bottom record. The carriage then reverses and travels back to its original position, but the bottom record is held by the Rods and drops on to the turntable. The vertical Rods then sink to their first position. When the record has been played the needle runs into the eccentric groove cut in its centre, and the wide swinging movement thus given to the arm operates a switch and stops the motor. The Meccano Motor then operates a Rod on which a sliding coupling is mounted, and lifts the pick-up clear of the turntable.

The record-changing mechanism now comes into operation, and the table is raised until it is on the same level as the edges of two grab arms. These arms are shown raised in the photograph, and they then descend towards the turntable. The arms are pivoted to a Flat Plate at their lower ends, and connected by a chain ; and when the chain is pulled downward by the mechanism the upper ends of the arms move apart. The chain is then released, and a spring brings the arms together again, so that they grip the record that has just been played. They then move back with the record towards the carriage, their movement being derived from the Meccano Motor, which operates them through a gear-box by means of Sprocket Chain and Sprocket Wheels. This mechanism appears in the front of the model in the photograph. When the grab arms are again drawn apart the record drops on to the pile of records on the carriage. The record is prevented from falling out on one side by the flanges of the Angle Girders of the arms, and on the other by the projecting shanks of $\frac{3}{4}$" Bolts secured in the elongated holes of the arms.

It should be noted that, owing to the manner in which the record is placed on top of the pile, its opposite side is presented to the needle of the pick-up when its turn arrives to be played again.

For the benefit of readers who wish to build an automatic gramophone of this kind it may be mentioned that although Boeke's model is fitted with an electric pick-up in order to reproduce through a valve amplifier, an ordinary acoustic sound-box such as that described and illustrated in the "*Suggestions Section*" of the September 1931 "*M.M.*" could be used if desired. A serviceable horn can easily be made either from cardboard or tin-plate.

The pick-up is mounted on an arm built of Angle Girders, and is pivoted so that it has free movement in all directions. It is electrically connected to a radio set in the usual manner. The Rod shown on the extreme right of the model moves the tone arm over to the rim of the record, and lowers it until the needle rests in the outermost groove.

Although the machine is designed to play five records it will work with a larger number if properly adjusted. All the records must be of the same diameter, however, otherwise the arm carrying the pick-up will have to be readjusted at each change of diameter.

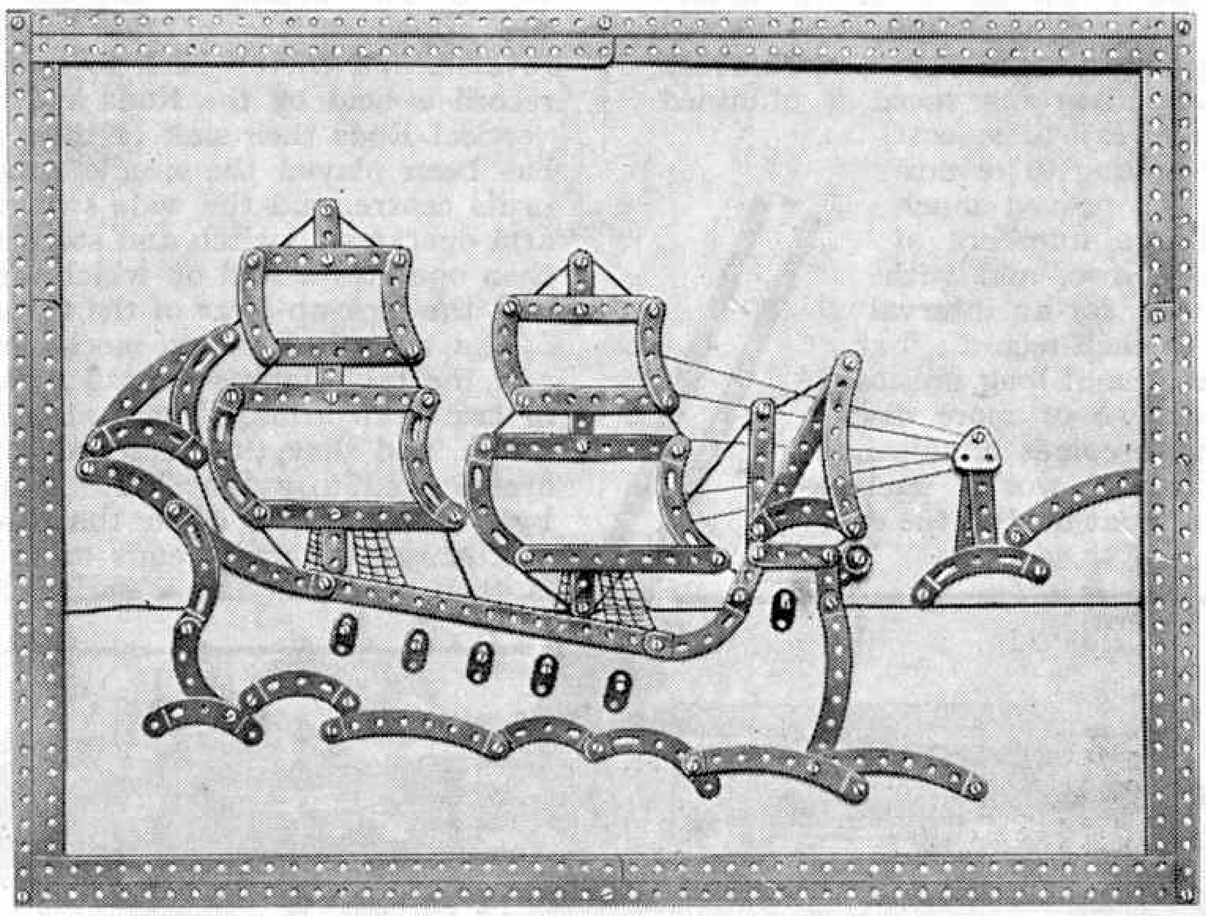
To prevent the vibration of the electric motors or noise of the gearing from spoiling the quality of reproduction, it was necessary to place rubber washers between them and the framework.

Meccano Model-Building Competitions

Novel "Picture" Contest

This competition offers a welcome change from ordinary model-building contests, and should attract a large number of entries. On this page appears a picture of a Meccano sailing ship. This picture, including the frame, is made entirely from simple Meccano parts bolted to a piece of cardboard that serves as a background. In spite of the fact that only a few parts are used, a very realistic effect has been obtained. In view of the great scope there is for making other pictures by this means, we are offering a number of fine prizes for the most interesting and novel Meccano "pictures" submitted to us by readers of the "*M.M.*"

We can assure intending competitors that it is great fun making pictures in this way, and there should be no difficulty in finding a suitable subject. Competitors may make any kind of picture they like best and may use any number of parts in its construction. A suitable subject would be a scene from a cricket match, and it would be quite easy to make realistic outlines of a batsman and bowler. Another good subject would be a street showing shops, and one or two big buildings such as a theatre and a church. A few minutes' thought will provide many other ideas for making really good and easy-to-build "pictures" that can be represented with the quantity of Meccano parts available. Competitors who wish to increase the realism of their "pictures" may do so by painting the cardboard background in suitable colours. In the case of the picture illustrated on this page, the sea was painted blue and the sky white.



This framed picture of a sailing ship, made up of Meccano parts bolted to a cardboard background, illustrates the requirements of the novel competition announced on this page.

After the "picture" is complete the competitor should obtain a good photograph of it. This may be taken either by the competitor himself or by a professional photographer.

Entries will be divided into two Sections as follows—Section A, for competitors of all ages living in the British Isles; and Section B, for competitors of all ages living Overseas.

The competitor's age, name and full address must be written clearly on the back of each photograph sent in, and entries addressed to "Meccano Picture Competition," Meccano Ltd., Binns Road, Liverpool 13. Entries for Section A must be posted to reach Liverpool not later than 30th March, 1935. The Overseas Section (B) will remain open for entries until 31st May, 1935.

It should be noted that photographs or drawings of prizewinning models become the property of Meccano Ltd. Unsuccessful entries will be returned if a stamped and addressed envelope is enclosed with the entry.

"Limited Parts" Simplicity Competition

This month's competition differs slightly from previous simplicity contests. In past competitions of this type, competitors were allowed to include in their models as many Meccano parts as they wished; but in the present contest models must be built with not more than 15 parts, excluding nuts and bolts. Any kind of parts may be used, however, and models may represent any type of subject. The main things the judges will look for when awarding the prizes will be realism and novelty of subject. The Meccano parts used must not be bent or otherwise mutilated, and it should be clearly understood that the specified number of parts, 15, does not include nuts and bolts, any number of which may be used according to requirements.

The actual model must not be sent; a photograph or a good drawing is all that is required. The competitor's age, name and address must be written on the back of the entry, and the number of parts contained in the model also must be stated. Entries should be addressed to "Limited Parts" Simplicity Contest, Meccano Ltd., Binns Road, Liverpool 13. Entries will be divided into two Sections, (A) for competitors living in the British Isles, and (B), for those living Overseas. Entries for Section A must be posted in time to reach Liverpool before 28th February, 1935. Section B will remain open for entries until 31st May, 1935.

Prizes Offered in these Competitions

Meccano "Picture" Contest

The prizes in each Section (A and B) are as follows:
First Prize: Meccano or Hornby Goods value £3-3s.
Second Prize: Meccano or Hornby Goods value £2-2s.
Third Prize: Meccano or Hornby Goods value £1-1s.
Five Prizes of Meccano or Hornby Goods value 5/-.
Five Consolation Awards of Goods value 2/6.

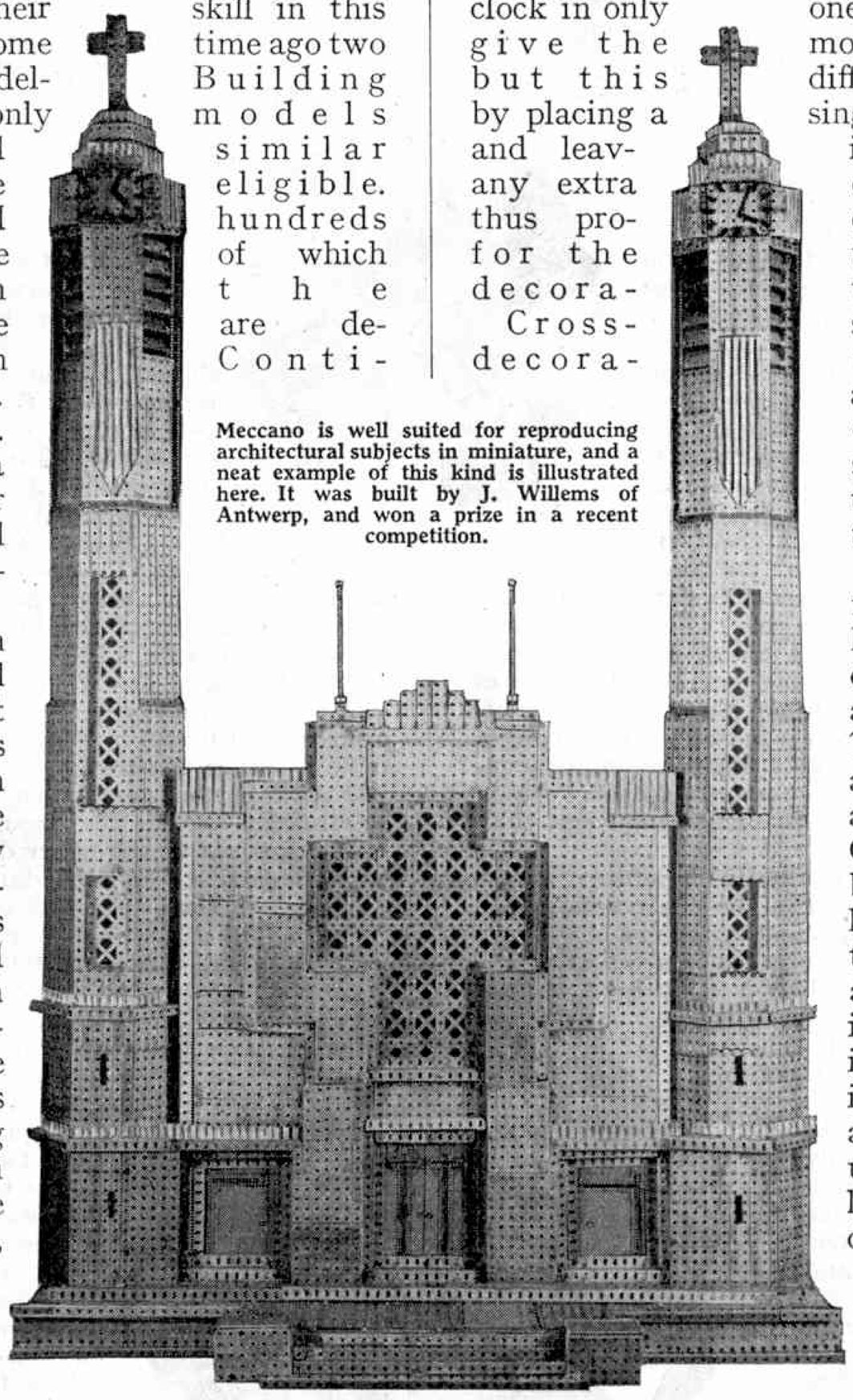
"Limited Parts" Simplicity Contest

The following prizes will be awarded in each Section:
First Prize: Meccano or Hornby Goods value £2-2s.
Second Prize: Meccano or Hornby Goods value £1-1s.
Third Prize: Meccano or Hornby Goods value 10/6.
Five Prizes of Meccano or Hornby Goods value 5/-.
Five Consolation Awards of Goods value 2/6.

Continental Church Built in Meccano

A Fine Architectural Model

ALTHOUGH the Meccano parts are designed specially for building models of machines and mechanisms, they can be used also with good effect for making models of architectural subjects. We have received a large number of fine models of this type from model-builders all over the world, and in order to encourage Meccano users generally to try their skill in this kind of work we organised some time ago two special "Architectural" Model-Building Competitions, for which only models of buildings, monuments and similar architectural subjects were eligible. Each of these Contests attracted hundreds of really interesting entries, some of which have already been illustrated in "*M.M.*"; and on this page we are describing a fine model of a modern Continental church, built by J. Willems of Antwerp, Belgium. This competitor has been a keen Meccano enthusiast for many years, and has won several prizes in "*M.M.*" model-building competitions.



Meccano is well suited for reproducing architectural subjects in miniature, and a neat example of this kind is illustrated here. It was built by J. Willems of Antwerp, and won a prize in a recent competition.

The church is nearly 6 ft. in height from the ground level to the tops of the crosses that surmount the towers, and is approximately 3 ft. 3 in. in width across the base. The model does not represent any existing church, but was designed by Willems from his own ideas. It is constructed in a style now favoured on the Continent, and the cruciform design, which forms the main theme of the building, is used to advantage in shaping the great central window in the facade. The doors also are decorated with a cross design, but they are made from cardboard instead of standard Meccano parts, which rather spoils the Meccano interest in this portion of the building. Angle Girders bolted across the tops of the doorways give a neat finish to these parts of the model, and further Angle Girders are used to form steps.

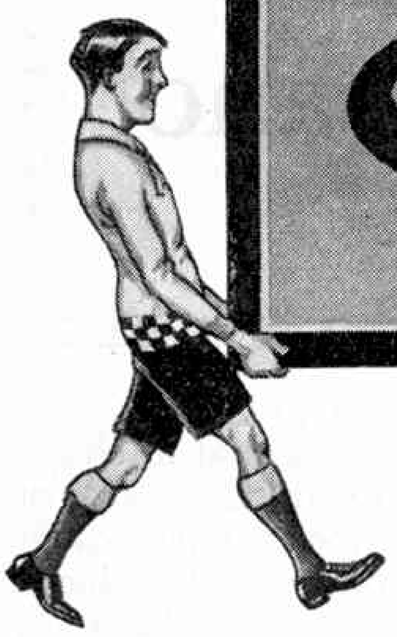
At each side of the central door, which is recessed into the face of the wall, is a column, and these are arranged so that they fit into the general scheme of the cross design of the large window. The central portion of the building between the towers is of very modern design, the work being carried out by skilful use of Plates, Flat Girders and Strips. This portion of the building is decorated with two pinnacles made from Rods fitted at their bottoms with Collars and at their upper ends with Handrail Couplings.

The upper parts of the towers are octagonal in shape and are topped with structures built in the form of crosses, made from Strips. Twin clocks with cardboard faces are mounted in the towers. Two clocks are really unnecessary on a building of this kind. A clock in only one of the towers would of course give the model an unbalanced appearance, but this difficulty could have been avoided by placing a single clock over the large window and leaving the two towers without any extra decoration. The general effect thus produced would be more realistic, for the towers have plenty of other decorations.

Cross-shaped designs form the main decorations of the building, and although they are so numerous they are so carefully and skilfully blended together that they are quite unobtrusive in the completed structure.

Particularly well-built features are two slatted ventilators, one in the top of each clock tower, and they possess a very realistic appearance. The slats of these ventilators are formed from 2" Flat Girders and are fixed to the Angle Girders of the main frame by other Girders. The ventilators form part of the decorative scheme of the model, and additional embellishment is provided by designs cut in cardboard and tinplate. It is interesting to note the decorated glass effect obtained by using Braced Girders for the large windows over the central door and the vertical windows in the towers. It will be seen that the Braced Girders are fixed in an upright position and that the Strips are bolted across them to divide the windows into squares. There are many other points of interest in the model, but the description we have given will be sufficient to show that really worth-while work can be done in making models of architectural subjects. Readers who have not tried their skill in work of this kind should do so immediately for there is a great deal of pleasure to be had in this branch of model-building, and the scope is wide and varied.

Readers who build good models of this kind are invited to send details and photographs of their work to us, so that if suitable, the models can be illustrated in future issues of the "*M.M.*"



Suggestions Section

Edited by "Spanner"

The ideas printed in the "Suggestions Section" should prove a real help to thousands of Meccano enthusiasts. Often we receive letters from readers who describe how they have solved some knotty problem or evolved an interesting model after studying some of the ideas that have appeared. We shall always be pleased to receive further contributions for the "Suggestions Section." Cash payments are made for all Suggestions published (excluding those mentioned in the "Miscellaneous" Suggestions column). Contributions should be accompanied by clear photographs or drawings and should be addressed to "Spanner," c/o The "Meccano Magazine."

(320)—Synchronous Electric Motor (A. R. Lamb, Melbourne)

A SYNCHRONOUS electric motor is a special type of alternating current motor. It has a multi-polar armature, and rotates at a constant speed that is governed partly by the frequency of the alternating current supplied to it and partly by the number of poles on the armature.

The complete Meccano model is illustrated in Fig. 320 and the upper illustration shows the armature separately. It will be seen that the armature is not wound with wire, and the action of the motor depends upon magnetic attractions and repulsions between the poles 2 of the armature and those of the electro-magnets 5.

A synchronous motor can only be started by rotating the armature at approximately its normal speed, and its action is best explained by supposing it to be running at this speed. As a pole of the armature approaches a pole of the electro-magnet, which we can suppose at the moment to be a north pole, south magnetic polarity is induced in the armature pole and it is then attracted. When the two poles are opposite to each other the direction of the alternating current in the windings of the electro-magnet is changed, and the north pole of this magnet becomes a south pole. The south polarity of the armature pole lags behind, however, and as this pole swings past the electro-magnet owing to its impetus, repulsion then comes into play, thus continuing the rotation of the armature. This alternation of attraction and repulsion is repeated for each pole of the armature, which is thus kept in rotation. The motor constituting this model will be found to have a second speed, which is half the normal speed, but the motor is then less efficient than when running at its usual rate.

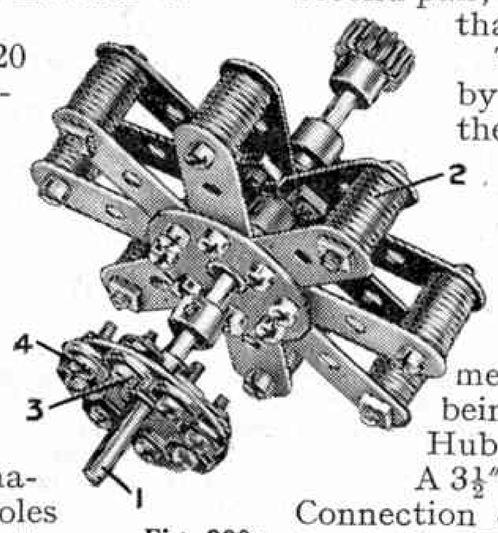


Fig. 320a

This motor can be used for driving models in the ordinary way, but it is specially interesting when used in the construction of a clock that operates without an escapement mechanism. Such a clock is quite simple to construct. First of all it is necessary to determine the speed of the motor. This is done by ascertaining the frequency of the current, which is indicated on the mains supply meter, doubling this, and then dividing it by the number of poles on the armature. The result will give the number of revolutions of the motor per second, and having this information it is only necessary to arrange suitable reduction gearing between the motor and the hands.

The model is essentially an electric motor but by fitting a commutator and brush gear it can be used to convert alternating current from a transformer to intermittent direct current.

The motor side frames are made from Hub Discs that are secured by 2½" Triangular Plates to 7½" Angle Girders, and the frames are joined together by 2½" Angle Girders and 2½" Strips. The Strips are spaced from the Hub Discs by two Collars on each ¾" securing Bolt, and support the electro-magnets 5. These each consist of a Magnet Coil and Core, Elektron Parts Nos. 1538 and 1539 respectively. The outer wire of the upper Coil and the inner wire of the lower one are connected to the frame, the remaining wires being connected together and to the inner wire of one of the remaining Coils and the outer wire of the other. The remaining two wires from the second pair of Coils are connected to the Insulated Terminal 7. To facilitate making connections, 6 B.A. Bolts are arranged on the rim of one Hub Disc but are insulated from it. It will be noticed that opposite pairs of Coils are connected in series-parallel arrangement. Thus the current flows through first one pair and then the second pair, and returns to the Transformer through the terminal 6 that is in contact with the frame.

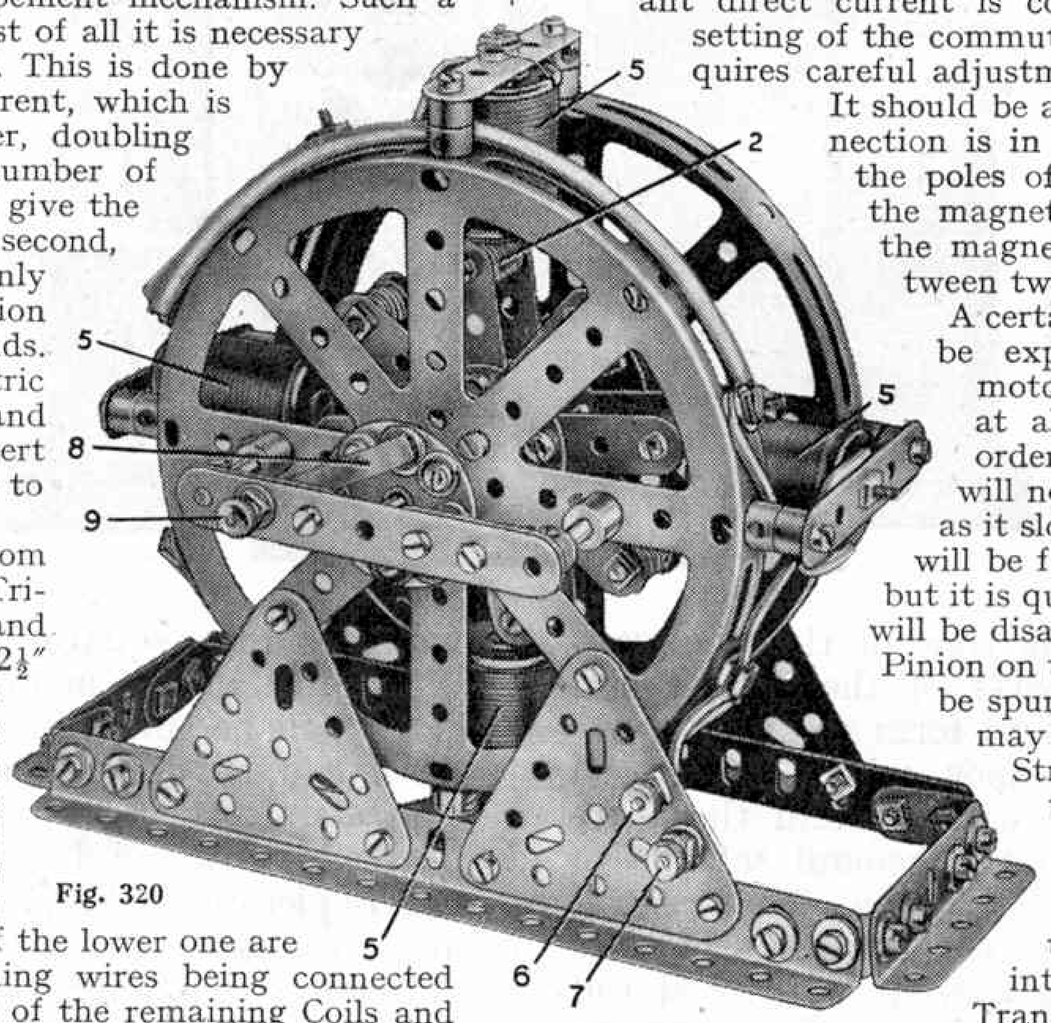


Fig. 320

The armature is illustrated in Fig. 320a. This is built up by bolting eight 1½" Strips to each of two Bush Wheels, the ends of the Strips being connected together by ¾" Bolts, each of which carries 12 Washers that form the poles of the armature.

If it is required to use the motor for converting alternating to direct current, a simple commutator should be made, as shown, by arranging eight 6 B.A. Bolts on a Bush Wheel. Alternate Bolts are in metallic contact with the Bush Wheel, the other four being insulated. Two Rod Sockets, secured to one of the Hub Discs, carry 1" Rods on which Cranks are secured. A 3½" Strip is bolted between the Cranks, and the Pendulum Connection 8 is attached as shown but insulated by means of Insulating Bushes. The Bolt carries a terminal 9. The Pendulum Connection, which serves as a brush, is so arranged that it is in contact with one of the insulated 6 B.A. Bolts during say the negative half cycle, and is in contact with one of the non-insulated Bolts (that is, in direct contact with the frame) during the other phase. In this manner one half of the complete cycle is cut out entirely, but it will be apparent that it is not possible to predetermine whether the negative or positive portion is cut out. With the arrangement as shown it will be found that sometimes on starting the motor, the direct current flows in one direction, and at other times in the other direction, but a reversing switch can be arranged in the secondary circuit if necessary. As half the cycle of the alternating current is cut out entirely, the resultant direct current is consequently only intermittent. The setting of the commutator in relation to the armature requires careful adjustment to produce satisfactory results. It should be arranged so that the Pendulum Connection is in contact with one of the Bolts when the poles of the armature are midway between the magnets. When the cores come opposite the magnets the Pendulum Connection is between two of the commutator Bolts.

A certain amount of difficulty will probably be experienced when first starting the motor. It is necessary to spin the armature at almost the exact required speed in order to start it, and if turned too fast it will not adjust itself to the required speed as it slows down. With a little experience it will be found fairly easy to start the motor, but it is quite likely that the first few attempts will be disappointing. It is a good plan to fix a Pinion on the armature shaft and if this cannot be spun quickly enough with the fingers, it may be turned by engaging a 6½" Rack Strip that is drawn across the Pinion, thus causing it to rotate.

The model is suitable for use as a motor with a T6, T6M or a T6A Transformer, but if it is required to use it as a converter, to supply intermittent direct current, the T6A Transformer should be used, as this is capable of delivering a greater output. On this Transformer there are three pairs of output sockets and the 9 volt or 3½ volt output may be converted to direct intermittent current.

(321)—Shaft Governor (F. Sanders, Glasgow)

Stationary steam engines must be fitted with some form of governing device to maintain a steady speed and to prevent "racing" when the engine is relieved of its load, or in the event of a failure in the drive transmission. The governors operate under the influence of centrifugal force which causes weights on a rotating shaft to move outward, the extent of their movement being dependant upon the speed of the shaft. The weights are connected by link motion to operate the throttle valve, thus regulating the amount of steam entering the cylinder.

Another form of governor is fitted to the crankshaft and varies the throw of the eccentric that operates the slide valve. The mechanism is generally embodied in the flywheel, and as the speed of the engine increases, the eccentric throw is reduced, thus diminishing the amount of steam admitted to the cylinder.

A model of this type of governor is shown in Fig. 321. The flywheel is formed from two Hub Discs bolted together back to back and secured to a Bush Wheel at the centre. The crankshaft is secured in the Bush Wheel and its end protrudes and carries the Rod Socket 1. A 1½″ Strip is pivoted on the screwed shank of the Socket and is retained in place by means of lock-nuts. The weights 2 are each formed from three sets of four 2½″ large radius Curved Strips bolted together with the ends overlapping two holes, and are pivoted on ½″ Bolts 3. Lengths of Spring Cord are attached as shown so that the weights are normally held close together.

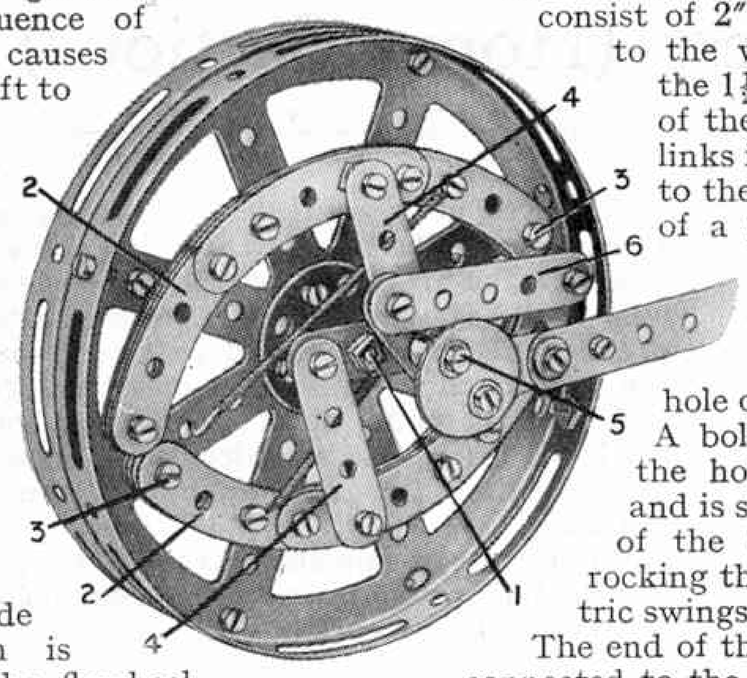


Fig. 321

The connecting links 4, which consist of 2″ Strips, are pivoted to the weights and also to the 1½″ Strip at the centre of the Wheel. One of the links is pivotally attached to the 1½″ Strip by means of a ¾″ Bolt that passes through the boss of a Single-Throw Eccentric and also through the centre hole of a Threaded Crank. A bolt is passed through the hole in the Eccentric and is screwed into the boss of the Crank, so that by rocking the Crank, the Eccentric swings about the ¾″ Bolt 5. The end of the Crank is pivotally connected to the outer end of one of the pivoted weights by means of a 2½″ Strip 6 that is slightly cranked.

When the device is in operation centrifugal force causes the weights 2 to fly outwards against the action of the Spring Cord, and the links 4 turn the 1½″ Strip about its central pivot 1. At the same time the link 6 pulls on the web of the Threaded Crank and so rotates the Eccentric about its boss. Thus the outward movement of the weights decreases the effective throw of the Eccentric according to the speed of the engine. As the speed is reduced, the Spring Cord pulls the weights together again and thus the Eccentric throw is increased.

(322)—Pincer Grab (E. Tompkins, Bristol)

Bucket type grabs are used extensively for handling loose material such as sand, gravel or earth, but for large blocks and stones it is generally necessary to resort to slinging, which takes considerably longer. An ingenious type of grab or handling large stones has been devised by Messrs. Bucyrus-Erie Co., and a model of this device is illustrated in Fig. 322. The Meccano grab can be used in connection with a model crane or excavator and will give hours of fun handling miniature blocks of stone in a model quarry, etc.

The suspension block is made from two 2″ Strips and 1″ Corner Brackets, spaced apart about ½″ by means of ¾″ securing Bolts. The hoisting cord 4 is tied to one of these Bolts and the other Bolt carries a ½″ loose Pulley and two Washers. The Rod 1, passed through the 2″ Strips and Corner Brackets, serves as a pivot for the curved arms to which the gripping jaws are attached. Each arm is made of two 2½″ small radius Curved Strips to which 4½″ Strips are bolted. Collars are used as shown for spacing the Strips apart and making the arms rigid.

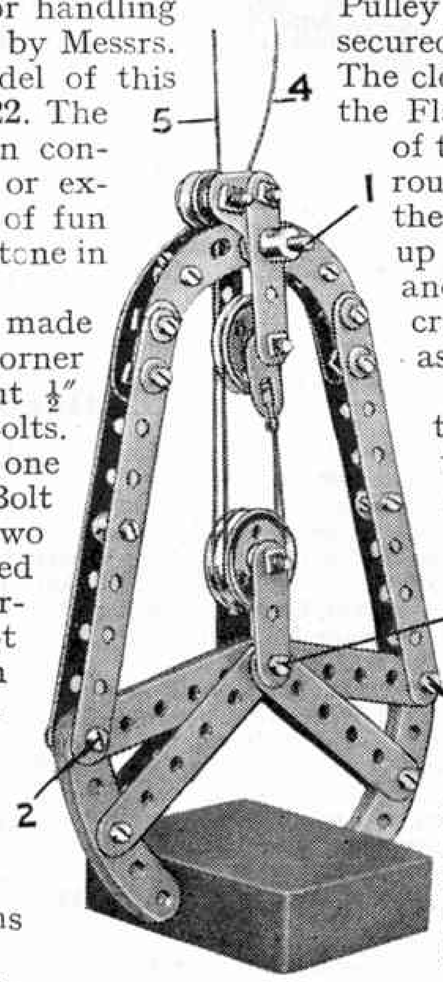


Fig. 322

The jaws each consist of six 2½″ large radius Curved Strips, and are pivoted on the ½″ Bolts 2. Each of the latter carries also two 3″ Strips, and a further pair of 3″ Strips is rigidly bolted at the centre hole of each jaw. The two pairs of Strips on each jaw are pivoted on the ¾″ Bolt 3, which carries also two 1½″ Strips. A ¾″ Bolt, passed through the upper ends of the 1½″ Strips, carries two 1″ loose Pulley Wheels between which a Washer is placed for spacing purposes. The 2″ Strips of the suspension block carry a 1″ loose Pulley and Flat Bracket, on a ¾″ Bolt secured in the lower holes of the Strips. The closing "rope" 5 is tied at one end to the Flat Bracket and passes round one of the lower 1″ Pulleys. It then passes round the upper 1″ Pulley and round the second lower Pulley, to be passed up through the Strips of the frame and over a Pulley at the head of the crane jib. The ½″ loose Pulley serves as a guide for the cord.

To open the grab the weight is taken by the hoisting cord 4, and the cord 5 is paid out. Thus the jaws are opened, and by hoisting on the cord 5 they can be closed to grip the article that is to be raised. The weight of the load increases the pull on the cord and in consequence the upper and lower Pulleys are pulled together and the grip on the load is increased. It is important that the hoisting cord 4 should remain slack when the grab is lifting a load. To release the load the cord 4 is hauled in and the cord 5 paid out.

The model crane or excavator to which the grab is fitted must have two hoisting drums that are suitably geared to operate independently or in unison. When the grab is being raised or lowered both cords must be hauled in or paid out together, but one remains fixed when the grab is opened or closed.

Suggestions Voting Contest

Once again we are organising a Voting competition to ascertain which suggestions are the most popular with "*M.M.*" readers. From January to December (inclusive) 1934, twenty suggestions were included in the "Suggestions Section," and competitors are asked to write down which four of these they consider to be the best in order of merit. The suggestions published number from 300 to 319, and it is necessary to put only the numbers on a postcard. The suggestion that is considered the best should be written first, and the second best next, and then the third and fourth, and the competitor's full name and address should be written below. Only one list of suggestions may be submitted by each entrant.

The contest is divided into two Sections, Section A for competitors residing in the British Isles, and Section B for Overseas competitors. The two Sections will be treated entirely separately, every vote received being recorded so that the suggestions may be classified in their order of popularity. In each Section the competitor whose list is found to coincide most nearly with the final result of the voting will be presented with a cheque for £1-1s. The next nearest to the general opinion of the voters will be awarded a cheque for 10/6, and twelve "runners-up" will receive consolation prizes.

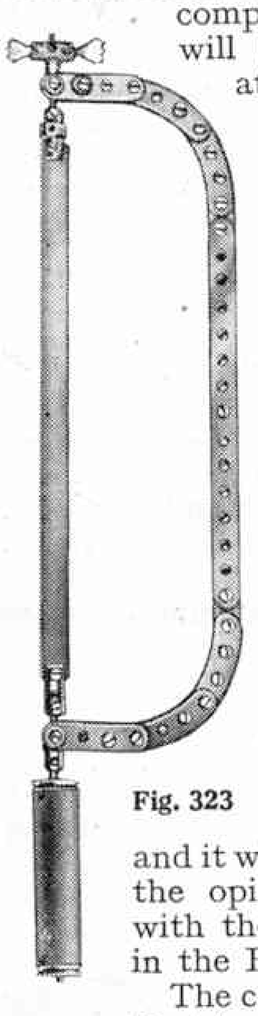


Fig. 323

By treating the entries for both Sections separately, it is possible for different suggestions to appear in the results, and it will be interesting to compare the opinions of Overseas readers with those of competitors residing in the British Isles.

The contributor of the suggestion that is voted best in one or both of the Sections will receive a cheque for 10/6, and the other contributors whose suggestions appear in the final results of the voting will receive consolation prizes.

Postcards must be addressed to "Suggestions Voting" Competition, Meccano Ltd., Binns Road, Liverpool 13. The closing date for Section A is 30th March, and for Section B, 30th April.

(323)—Hacksaw

(W. R. H. Temple, Shanklin)

Useful tools, built entirely of Meccano parts, have previously been dealt with from time to time in these pages. Yet another instance of the practical uses of Meccano is shown in the model hacksaw in Fig. 323. The frame is built up from two 9½″ Strips, outside which are two 7½″ Strips. Curved Strips are bolted at the ends of the 9½″ Strips, and Washers are placed between them to make them rigid.

At the outer ends of the Curved Strips, 2″ Strips are bolted, and each pair of the latter carries a Coupling that is fixed by bolts inserted through the Strips and screwed into the tapped bores. A Rod is passed through the lower Coupling and carries a Wood Roller fitted between two 1″ Pulley Wheels to form a handle. A Strip Coupling is carried on the inner end of the Rod to hold one end of the hacksaw blade, the other end of which is carried in another Strip Coupling secured to a Screwed Rod.

Model-Building Competition Results

By Frank Hornby

"September" Contest (Home Sections)

The principal prizewinners in Sections A and B of the "September" Model-Building Contest are as follows:

Section A (Home competitors over 14 years of age)

FIRST PRIZE, Meccano or Hornby Goods value £3-3s.: C. Ingleby, Westgate-on-Sea, Kent. SECOND PRIZE, Goods value £2-2s.: H. Lee, Ardrossan, Ayrshire. THIRD PRIZE, Goods value £1-1s.: E. Reynolds, Birmingham.

FIVE PRIZES of Meccano or Hornby Goods value 10/6: P. Bradley, Stanmore, Middlesex; R. Lawford, Watford; P. Lucas, London, N.W.6; E. Stockley, Liverpool 11; W. Wilson, Eccles, Manchester.

FIVE PRIZES of Meccano or Hornby Goods value 5/–: A. Bell, Whitchurch; W. Caton, Liverpool 8; P. Caudle, Birmingham; R. Hough, Wallington, Surrey; D. Unwin, Cambridge.

Section B (Home competitors under 14 years of age)

FIRST PRIZE, Meccano or Hornby Goods value £3-3s.: J. Price, Wrexham. SECOND PRIZE, Goods value £2-2s.: C. Patterson, Hawick, Scotland. THIRD PRIZE, Goods value £1-1s.: G. Upcott, London, N.17.

FIVE PRIZES of Meccano or Hornby Goods value 10/6: E. Brett-Harris, Weston-Super-Mare; I. Clowes, Sheffield 8; H. McPherson, Clitheroe; P. Ward, Southampton; R. Williams, Twickenham.

FIVE PRIZES of Meccano or Hornby Goods value 5/–: M. Bryant, Skipton, Yorks.; V. Featherstone, Widnes, Lancs.; R. Symons, Plymouth; P. Hands, Hillingdon, Middlesex; J. Whiskard, London, S.W.5.

The First Prize model in Section A is the heavy traction engine, illustrated on this page. The best feature of the model is its neat and finished appearance, and I congratulate its builder, C. Ingleby, on his careful workmanship. The wheels of the model are worthy of special mention, for owing to the peculiar design adopted in actual traction engine wheels it is difficult to reproduce them accurately in Meccano. The hubs of the wheels are made from Face Plates, the rims of Circular Strips and the spokes of 4½" Strips, the diagonal strakes across the face of the wheels being represented by 2½" Strips.

The drive to the main gear train of the model is transmitted by Sprocket Chain from the armature shaft of a 20-volt Meccano Electric Motor. The model is capable of travelling at two speeds forward or in reverse, and the gear ratios are such that the model is easily able to haul its builder along the ground. Steering is effected by means of worm and pinion mechanism, and the movement of the handwheel is transmitted from the steering drum to the front wheel axle by means of Sprocket Chain. The front axle is mounted on a Ball Race.

H. Lee submitted a neatly built model steamer, which also is illustrated on this page. The hull is made from 12½" and 5½" Strips and was shaped without mutilating the parts used to any great extent. The fore and after decks are made from cardboard, and the deck rails from wire and ⅜" Bolts. Wire is used also for the wireless aerial, and Meccano Cord for the rigging.

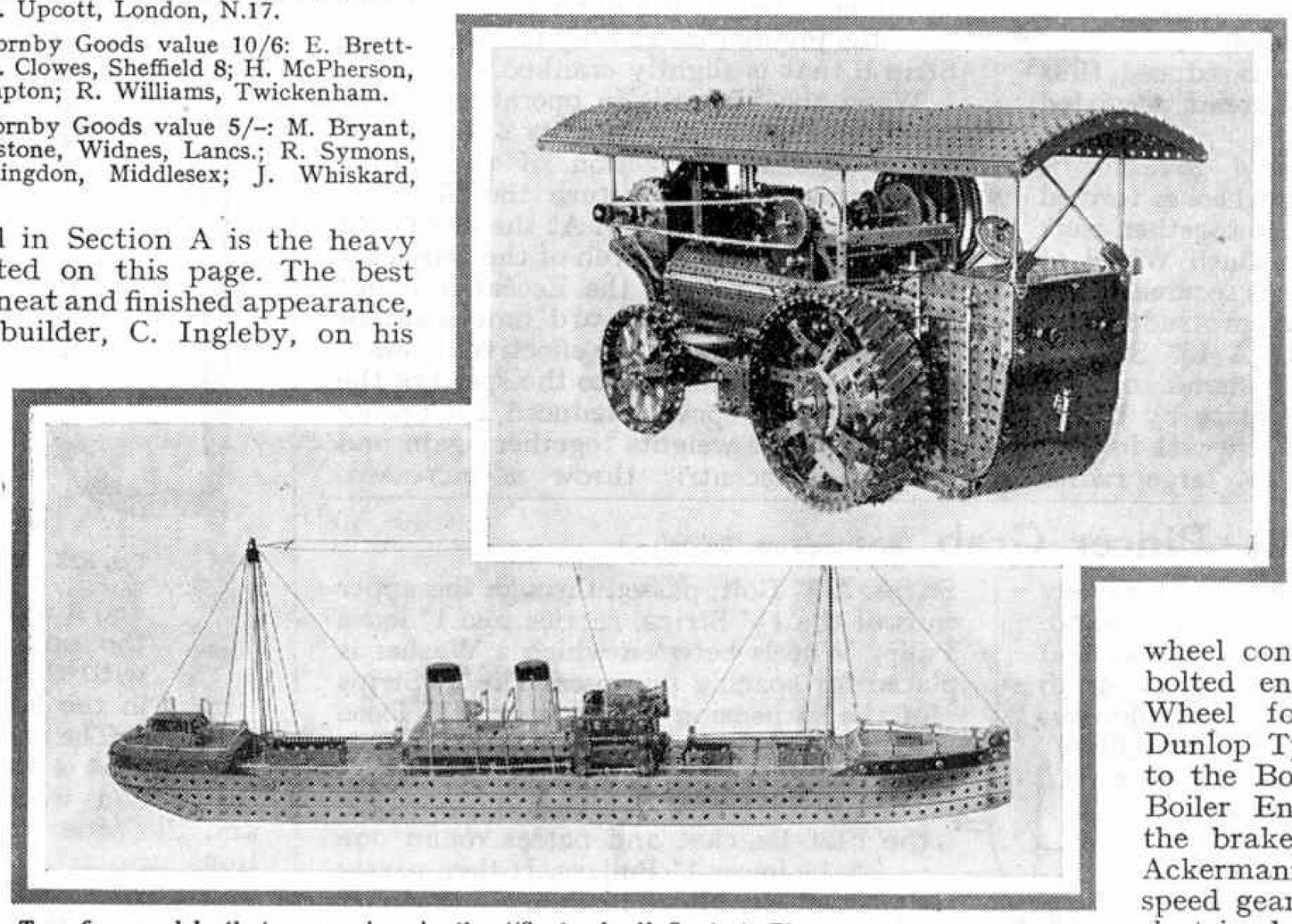
A well built model of a sports car chassis won Third Prize in this Section. This includes many interesting details and its construction shows that its builder went to considerable trouble to obtain good proportion between the different parts of the model. A 20-volt non-reversing Electric Motor, housed under the bonnet, drives the rear wheels through a three speed forward and reverse gear-box. From the gear-box the final drive is taken through a Universal Coupling to the axle, simple bevel gearing being used instead of the usual differential. The rear wheels are fitted with internal expanding brakes, but dummy brake drums and controls are fitted to the front wheels.

The great strength of Meccano structures when properly designed is displayed in a good model of a level luffing crane submitted by P. R. Lucas. The base of the crane will support a load of 10 stone, although the lifting mechanism is designed to handle weights up to only 30 lb. The model is neatly constructed throughout, and actual practice has been followed as closely as possible in reproducing the bracing of the jib and superstructure.

A realistic model of an Alfa Romeo four-seater sports car, built by J. M. Price, was awarded First Prize in Section B, but unfortunately the photograph submitted is not suitable for illustration purposes.

A model steamship also was one of the prizewinners in this Section. The model represents an ocean passenger liner and was built by Carl Patterson. Good work has been done in shaping the superstructure, but from a Meccano point of view the value of the model is lessened by the fact that the three funnels of the ship are made from cardboard instead of from Meccano parts.

The model that won a prize for G. S. Upcott is a copy of a Thorneycroft six-wheeled lorry. The chief measurements of the model are length 2 ft. 4 in., height 9 in. and width 6½ in. Each of the rear wheels is fitted with three tyres, and the manner in which this is done is interesting. Each wheel consists of two Boiler Ends bolted end to end with a Bush Wheel for the hub. Three 2½" Dunlop Tyres are then pressed on to the Boiler Ends, and the inner Boiler End on each wheel forms the brake drum. The chassis has Ackermann steering gear, a three speed gear-box, clutch, differential, electric headlamps and direction signals. It is interesting to note that the lorry is capable of hauling a load of 80 lb.



Two fine models that won prizes in the "September" Contest. The neat appearance of the model heavy traction engine is a tribute to the constructional skill of its builder, C. Ingleby, Westgate-on-Sea. The ship illustrated represents the latest effort of H. Lee, Ardrossan, who is an expert builder of ship models.

"Resemblances" Contest

The principal prizewinners in this Competition are as follows:

Section A (Home competitors)

FIRST PRIZE, Meccano or Hornby Goods value £2-2s.: T. Wilson, Coventry. SECOND PRIZE, Goods value £1-1s.: H. Swain, Bromsgrove, Worcs. THIRD PRIZE, Goods value 10/6: R. Nuttall, Burley-in-Wharfedale, Yorks.

SIX PRIZES of Goods value 5/–: J. Baker, Eastbourne; Y. Cairns, Glasgow, E.2; W. Lewis, Garnant, Carm.; G. Parker, Bury St. Edmunds; E. Tomlinson, Guildford; C. Wright, Swallow Nest, Sheffield.

Section B (Overseas Competitors)

FIRST PRIZE, Meccano or Hornby Goods value £2-2s.: C. Courtis, Johannesburg, S. Africa. Second Prize, Goods value £1-1s.: H. Parker, Brussels, Ontario, Canada. THIRD PRIZE, Goods value 10/6: A. Coppola, Sliema, Malta.

SIX PRIZES of Goods value 5/–: J. Jasper, Manly, Australia; J. Rodriguez, Montreal, Canada; V. Butcher, Kaiapoi, New Zealand; N. Mitchell, Christchurch, N. Zealand; D. Simpson, Otago, N. Zealand; N. Soderberg, Falun, Sweden.

July "Errors" Contest

Section A (Home competitors)

FIRST PRIZE, Meccano or Hornby Goods value £2-2s.: L. Willis, Lowestoft. (38 errors listed.) SECOND PRIZE, Goods value £1-1s.: C. Trimmer, Gillingham, Kent. (37 errors.) THIRD PRIZE, Goods value 10/6: J. Houghton, Cheltenham. (29 errors.)

TEN PRIZES of Goods value 5/–: P. Bayly, Plymouth; R. Bishop, London, S.E.6; J. Dobinson, Newport; J. George, Bordon, Hants.; W. Lewis, Garnant, Car.; W. Patterson, Newcastle 6; C. Sharpe, Ilford; F. Sillitoe, Langley, Birmingham; W. Winstanley, Liverpool 7; T. Hughes, London, W.10.

Section B (Overseas competitors)

FIRST PRIZE, Meccano or Hornby Goods value £2-2s.: J. Rodriguez, Montreal. (37 errors listed.) SECOND PRIZE, Goods value £1-1s.: J. Marshall, Thames, N. Zealand. (34 errors.) THIRD PRIZE, Goods value 10/6: Escary, Buenos Aires. (30 errors.)

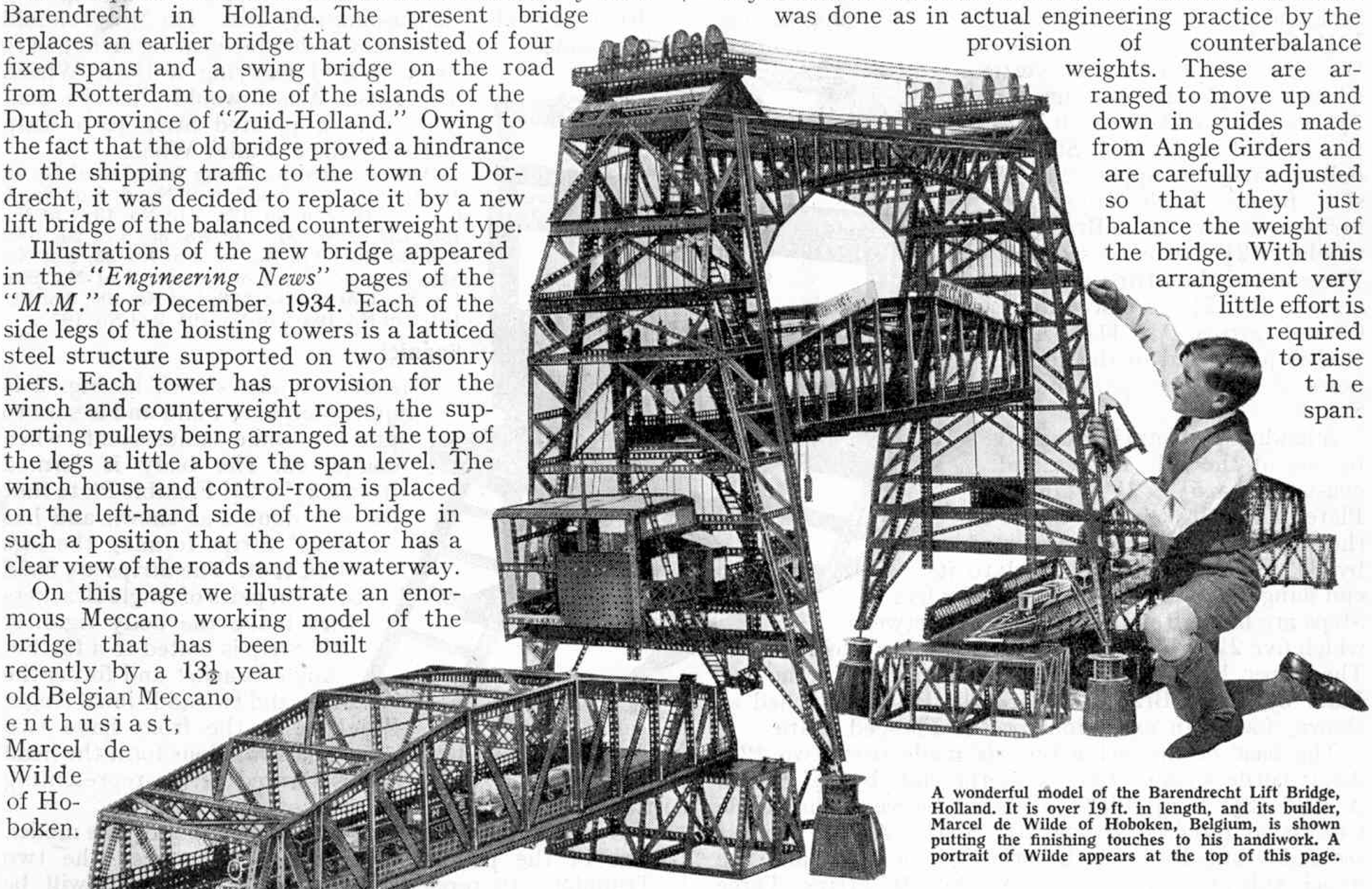
A Belgian Boy's Fine Model

Barendrecht Lift Bridge

A FINE lift bridge, which is said to be the largest of its kind on the Continent, is now in operation over the Oude-Meuse waterway near Barendrecht in Holland. The present bridge replaces an earlier bridge that consisted of four fixed spans and a swing bridge on the road from Rotterdam to one of the islands of the Dutch province of "Zuid-Holland." Owing to the fact that the old bridge proved a hindrance to the shipping traffic to the town of Dordrecht, it was decided to replace it by a new lift bridge of the balanced counterweight type.

Illustrations of the new bridge appeared in the "*Engineering News*" pages of the "*M.M.*" for December, 1934. Each of the side legs of the hoisting towers is a latticed steel structure supported on two masonry piers. Each tower has provision for the winch and counterweight ropes, the supporting pulleys being arranged at the top of the legs a little above the span level. The winch house and control-room is placed on the left-hand side of the bridge in such a position that the operator has a clear view of the roads and the waterway.

On this page we illustrate an enormous Meccano working model of the bridge that has been built recently by a 13½ year old Belgian Meccano enthusiast, Marcel de Wilde of Hoboken.



A wonderful model of the Barendrecht Lift Bridge, Holland. It is over 19 ft. in length, and its builder, Marcel de Wilde of Hoboken, Belgium, is shown putting the finishing touches to his handiwork. A portrait of Wilde appears at the top of this page.

The model represents the untiring efforts of six months' hard work, and about 8,000 Meccano parts are used in its construction. Although the model has only two fixed spans instead of three as in the original, its total length is slightly over 6½ yards! The height of the vertical towers that accommodate the hoisting machinery for the lift bridge is approximately 6 ft. 6 in., and the length of the lift bridge itself is 4 ft. 9 in. The model is built entirely from Meccano parts and from the illustration on this page it will be appreciated that a tremendous amount of patient work was entailed in carrying out the details of its construction.

The power for raising the bridge is provided by an old type high voltage Electric Motor, the bridge being suspended by means of four sets of two sheave Pulley Blocks at each side. It is interesting to note that over 60 yards of Meccano Cord were required to reeve the blocks and to connect up with the winding gear.

Owing to the great weight of the lift span it was necessary to reduce the load that the Motor had to handle. This was done as in actual engineering practice by the provision of counterbalance weights. These are arranged to move up and down in guides made from Angle Girders and are carefully adjusted so that they just balance the weight of the bridge. With this arrangement very little effort is required to raise the span.

The entire structure is illuminated by means of numerous small electric lamps, and when lit up at night presents a fairy-like spectacle. Some idea of its huge size can be gained from the fact that its builder is able to stand between the main girders of the vertical towers.

There are many praiseworthy features in the model quite apart from the faithfulness with which it reproduces its prototype. For example, the skilful use of Meccano X Series parts in making the piers and some of the bracing greatly enhances the constructional interest of the model. The Hornby Rails, Points and Rolling Stock with which the roadway of the bridge is equipped play a great part in giving the model a life-like appearance.

The model was constructed from photographs, and as Wilde has never seen the actual bridge, his achievement is all the more remarkable.

This clever young Belgian has been an enthusiastic model-builder since he was five years old, and he built his first really big model when he was only 11. In March 1933 he obtained First Prize in a competition for model cranes, and since that time he has won other prizes.

New Meccano Models

Swing Boat—Spaniel—Gramophone—Steam Wagon, etc.

THE imposing model swing boat illustrated on this page represents a fair-ground attraction that will be familiar to most readers. The base and side frames are first constructed by bolting 12½" Angle Girders across each end of a 5½" × 2½" Flanged Plate, and fixing further 12½" Girders near their ends. At the base of each pair of vertical Girders, a 5½" Strip is secured, and 5½" Strips brace the side frames to the base. Further 5½" Strips are bolted across the upper ends of the side frames. Each uppermost Strip carries two Angle Brackets, to which 12½" Strips are secured. The ends of the Strips are connected by 2½" small radius Curved Strips. An 11½" Axle Rod is journalled in the centre holes of the lower pair of 5½" Strips.

A landing platform is attached to one of the side frames and consists of a 5½" × 2½" Flanged Plate, bolted by one side flange to the Angle Girders, and supported by 3½" Strips that are bolted to its end flanges and also to the Angle Girders. Steps are made from two 5½" Strips, between which five 2½" × ½" Double Angle Strips are fixed. The upper Double Angle Strip is attached to the Plate by Angle Brackets. A Sector Plate, attached as shown, forms an extension for the Flanged Plate.

The base of the swing boat is made from two 12½" Angle Girders connected across the ends by 3½" Strips. A 12½" × 2½" Strip Plate is placed between the Angle Girders and bolted to the 3½" Strips. A 5½" Strip is secured vertically to each corner of the base, and the upper ends of these are connected by 12½" Strips. Three 3½" × 2½" Flanged Plates are bolted between the 12½" Strips, one being placed at each end and one at the centre. Two 4½" × 2½" Strip Plates are secured between the Flanged Plates, and 12½" Strips are bolted along the edges of the top. The lower half of one side is filled in by a 12½" × 2½" Strip Plate, and at the other side two 5½" × 2½" Strip Plates are fixed and a 5½" Strip secured along their upper edges. The gap between the two Plates serves as a doorway, and two 3½" and two 2½" Strips form the side posts. The ends of the boat are filled in by 2½" × 2½" Flexible Plates and 2½" Strips.

Two Trunnions are bolted at the centre of the roof, and Cranks are attached to them. The bosses of the Cranks are firmly gripped on the 11½" Axle Rod that is journalled between the side frames. A Collar is fitted on one end of the Rod, and at the other end is a 3" Pulley Wheel carrying a Threaded Pin. The handwheel so formed enables the boat to be rocked to and fro, and if a Clockwork or Electric Motor is available it can be arranged to drive the model with fascinating effect. The Motor should be mounted at the base and reduction gearing arranged to drive a Rod carrying a Bush Wheel. The Bush Wheel would then be connected by a pivoted Strip to a Strip bolted to the 3" Pulley Wheel.

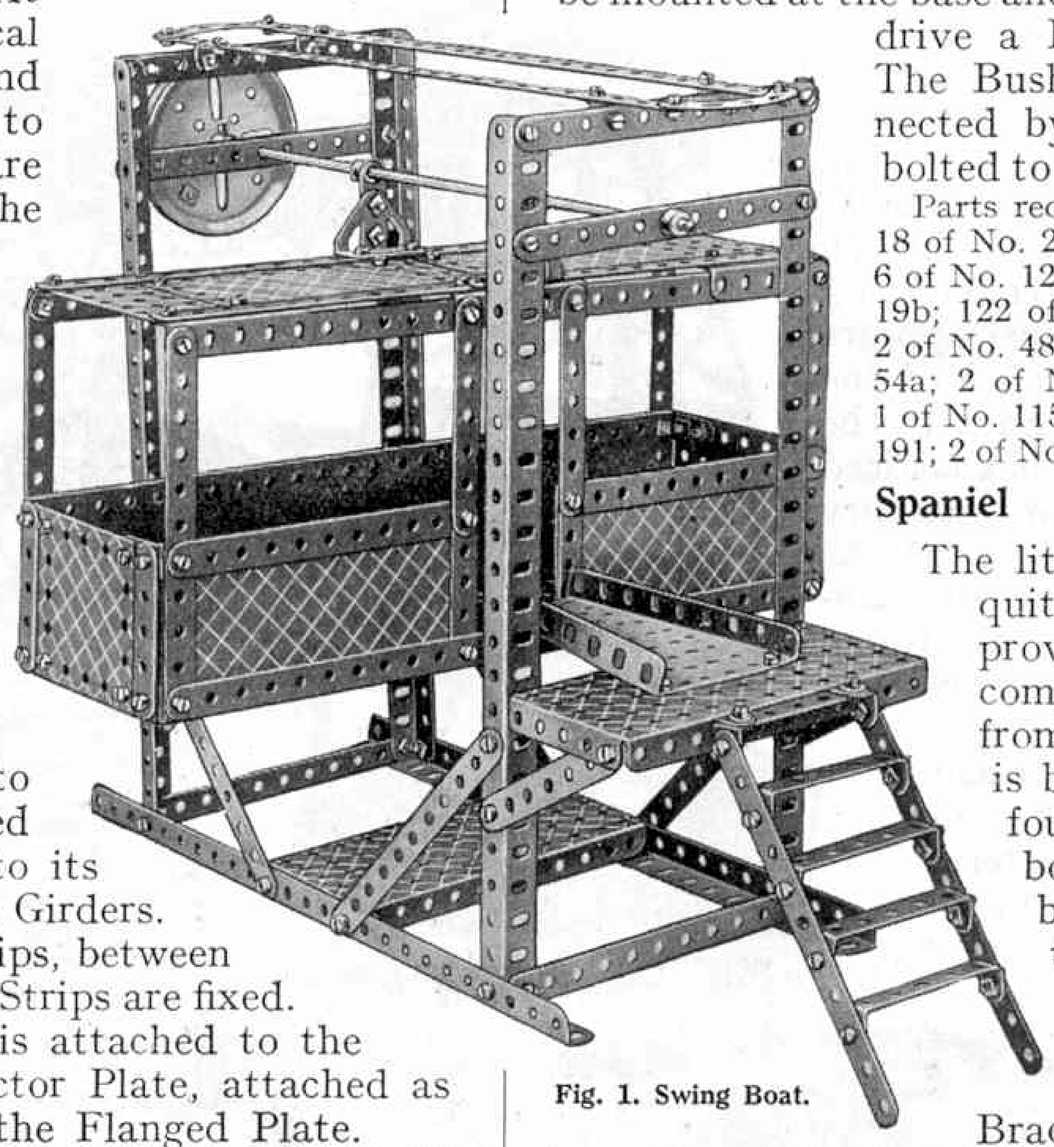


Fig. 1. Swing Boat.

Parts required for Swing Boat: 10 of No. 1; 18 of No. 2; 6 of No. 3; 6 of No. 5; 8 of No. 8; 6 of No. 12; 4 of No. 12a; 1 of No. 13; 1 of No. 19b; 122 of No. 37; 2 of No. 38; 5 of No. 48a; 2 of No. 48b; 2 of No. 52; 3 of No. 53; 1 of No. 54a; 2 of No. 59; 2 of No. 62; 2 of No. 90a; 1 of No. 115; 2 of No. 126; 1 of No. 190; 2 of No. 191; 2 of No. 193; 2 of No. 195; 2 of No. 197.

Spaniel

The little model shown in Fig. 2 is quite simple to build and is sure to provide some amusement when completed. The body is formed from a 2½" × 2½" Flexible Plate that is bent double as shown and has four 2½" Strips forming the legs bolted to it. The Strips are fixed between pairs of Angle Brackets that make the body rigid. A 2½" Strip is bolted to a further Angle Bracket and forms the tail, and two additional Angle Brackets at the front have two Trunnions bolted to them. The Trunnions form the head and carry 2½" small radius Curved Strips representing the long ears so characteristic of spaniels.

A novel use is found for the Lighting Set in this model. One of the pea lamps is clamped between the two Trunnions to represent the animal's eyes. It will be noticed that the one lamp can be seen on both sides of the head, and the clips for connecting to the battery are shown at the rear of the model. Two 2" Axle Rods are journalled in the lower ends of the legs and carry 1" Pulleys so that the model can be pushed along.

Parts required for Spaniel: 5 of No. 2; 7 of No. 12; 2 of No. 17; 4 of No. 22; 12 of No. 37; 2 of No. 90a; 2 of No. 126a; 1 of No. 190; Lighting Set.

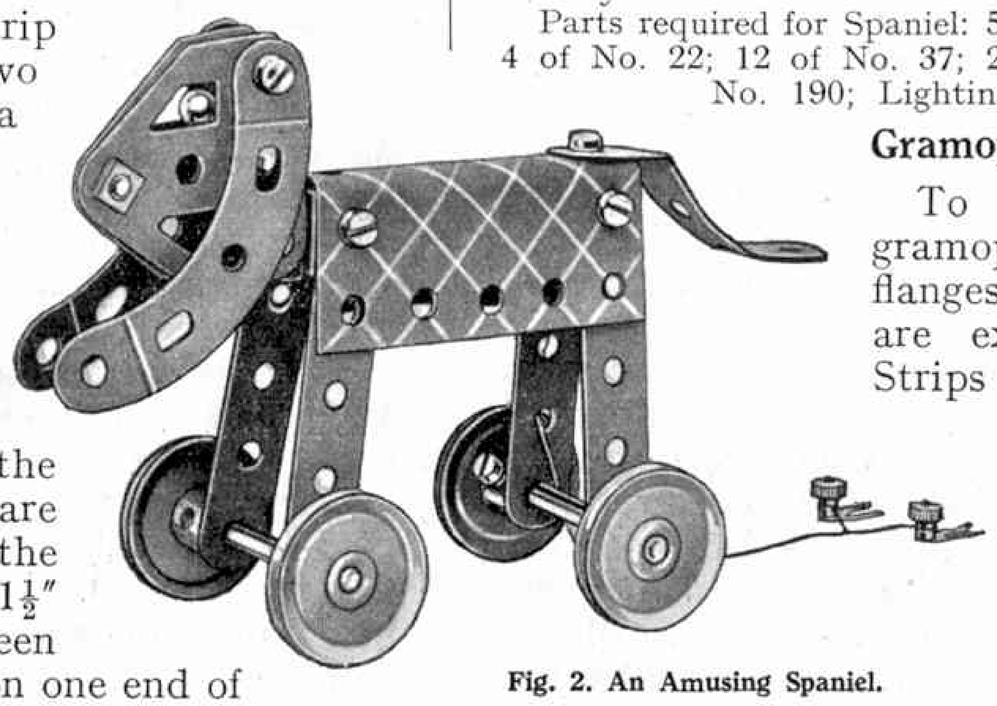


Fig. 2. An Amusing Spaniel.

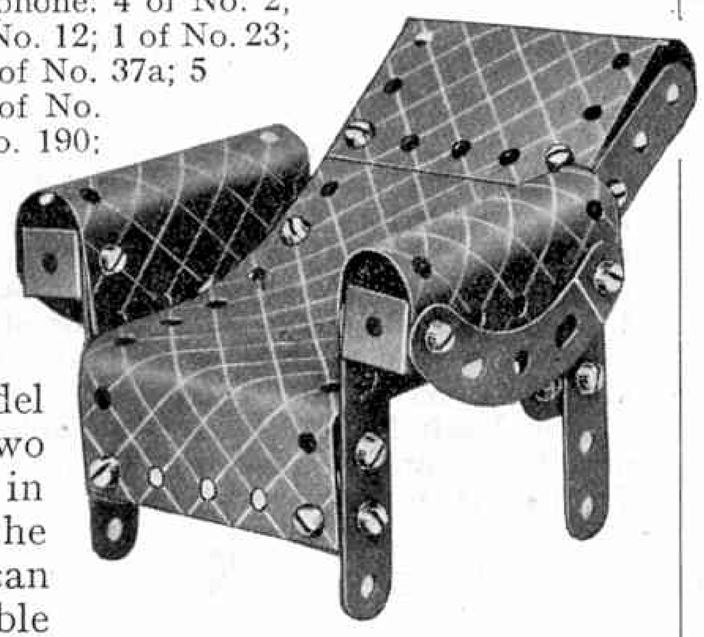
Gramophone

To build the realistic cabinet gramophone shown in Fig. 3, the side flanges of a 5½" × 2½" Flanged Plate are extended downwards by 2½" Strips that are secured to 4½" × 2½" Flexible Plates, the latter also being bolted to the flanges. At the top and bottom of each Flexible Plate a 2½" × ½" Double Angle Strip is secured and the front ends of these are

connected by $2\frac{1}{2}$" Strips. At the front of the cabinet two $2\frac{1}{2}" \times 2\frac{1}{2}"$ Flexible Plates are used for filling in purposes and are reinforced by $2\frac{1}{2}$" Strips and $5\frac{1}{2}$" Strips as shown. Two Flat Trunnions are used for filling in the space between the rear legs below the $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plate. The front of the cabinet is made to represent the two doors that give access to the horn and the record cupboard on an actual gramophone of this type. Knobs are represented by $\frac{3}{8}$" Bolts that are each held in place by two nuts.

A $2\frac{1}{2}" \times \frac{1}{2}"$ Double Angle Strip is bolted between the upper pair of Double Angle Strips and a $\frac{3}{8}$" Bolt, passed up through its centre hole, carries a Bush Wheel representing the turntable. A $\frac{1}{2}$" loose Pulley is used for the sound box and is bolted to Flat Brackets that are fixed inside the cabinet by Angle Brackets.

Parts required for Gramophone: 4 of No. 2; 5 of No. 5; 2 of No. 10; 4 of No. 12; 1 of No. 23; 1 of No. 24; 29 of No. 37; 5 of No. 37a; 5 of No. 48a; 1 of No. 52; 4 of No. 111c; 2 of No. 126a; 2 of No. 190; 2 of No. 191.



(Above) Fig. 4. Easy Chair.

(Below) Fig. 5. Steam Wagon.

Easy Chair

The new Meccano Flexible Plates and Strip Plates are excellent for reproducing model furniture and the two examples illustrated in Figs. 3 and 4 show the realistic results that can be obtained. The Flexible Plates are used to advantage in the model easy chair in Fig. 4, and in a similar manner a complete Chesterfield suite can be made. Four $2\frac{1}{2}$" Strips are used for the legs of the chair, and a $2\frac{1}{2}" \times \frac{1}{2}"$ Double Angle Strip is bolted between the centre holes of the front pair. Two further $2\frac{1}{2}$" Strips are attached to the Double Angle Strip and a second Double Angle Strip is bolted across the ends of these. Flat Brackets at the ends of the second Double Angle Strip are bolted to the centre holes of the rear legs, and one of the Flat Brackets can be seen in the illustration. The back of the chair is formed from two $2\frac{1}{2}$" Strips that are secured to the upper ends of the rear pair of legs, and Angle Brackets are fixed in both the lower end holes and centre holes.

The upholstered arms are made from two $2\frac{1}{2}" \times 2\frac{1}{2}"$ Flexible Plates that are bent over as shown, and bolted to Double Brackets at the front and $\frac{1}{2}$" Reversed Angle Brackets at the rear. The Reversed Angle Brackets are attached to the lower holes of the Strips forming the back. Curved Strips are fixed outside the arms. A $4\frac{1}{2}" \times 2\frac{1}{2}"$ Flexible Plate is bolted to Angle Brackets on the front legs and also to the two pairs of Angle Brackets on the chair back. A similar Plate overlaps the first and is bent round the back of the model to be secured to Angle Brackets that are fixed to the centre holes of the rear legs. A $2\frac{1}{2}$" Strip is fitted between these Angle Brackets.

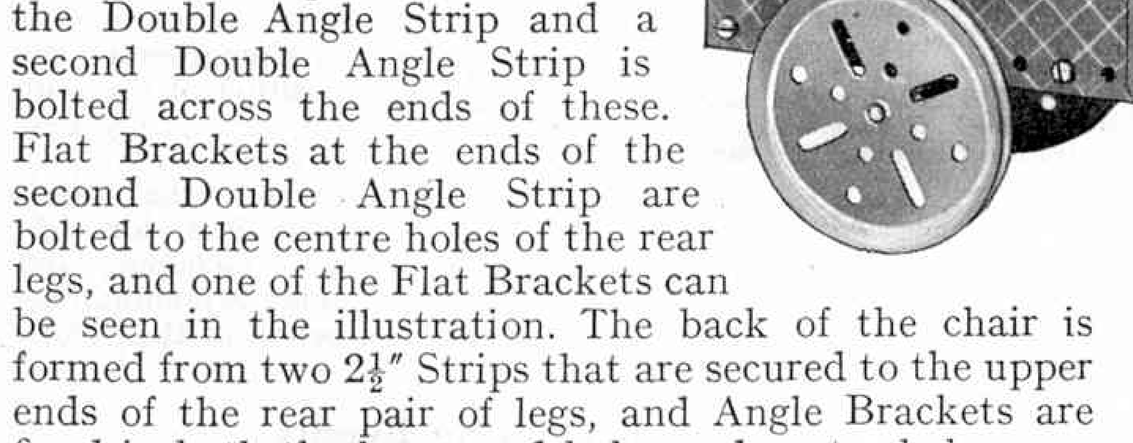


Fig. 6. Lumber Wagon and Horse.

Parts required for Easy Chair: 9 of No. 5; 2 of No. 10; 2 of No. 11; 8 of No. 12; 32 of No. 37; 2 of No. 48a; 2 of No. 90a; 2 of No. 125; 2 of No. 190; 2 of No. 191.

Steam Lorry

The main frame of the model steam lorry (Fig. 5) is made by securing a Sector Plate to the end of a $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plate by means of Angle Brackets. The lorry body is made by bolting $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flexible Plates to the sides of the Flanged Plate, and a $2\frac{1}{2}" \times 2\frac{1}{2}"$ Flexible Plate at the rear. Two $3\frac{1}{2}$" Strips are bolted vertically at the front corners of the Flanged Plate and the upper ends of these support another Sector Plate that forms the top of the cab. The Sector Plate is braced by $2\frac{1}{2}$" Curved Strips, and a $2\frac{1}{2}" \times 1\frac{1}{2}"$ Flanged Plate is fixed between the vertical Strips to complete the lorry body and also to form the rear of the cab. A Double Angle Strip is attached to this Flanged Plate by Angle Brackets and represents a seat, and Flat Trunnions are bolted to the lower Sector Plate to fill in the cab sides.

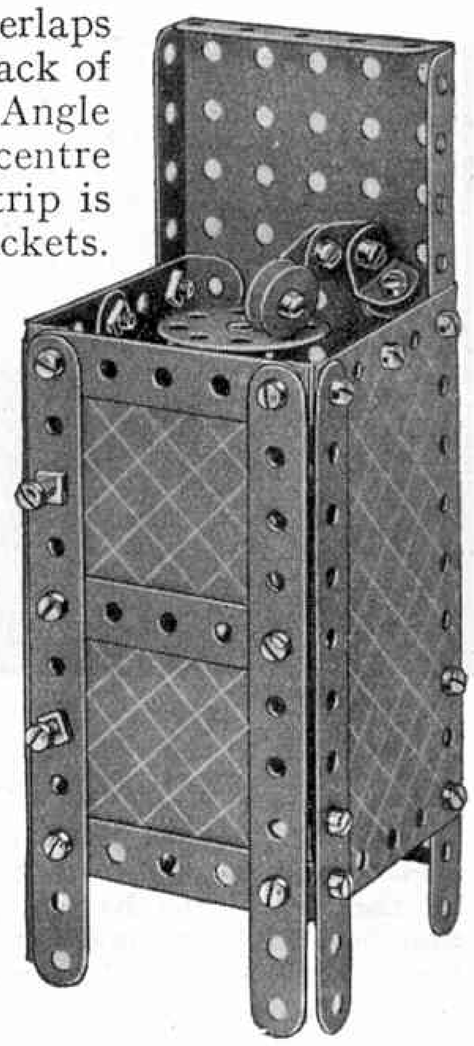


Fig. 3. Cabinet Gramophone.

A boiler is made by bolting a $2\frac{1}{2}" \times \frac{1}{2}"$ Double Angle Strip to a Bush Wheel which is provided with seven Angle Brackets. A $2\frac{1}{2}$" Strip is bolted to each Bracket, and the upper $2\frac{1}{2}$" Strip is connected at the rear to the lower Double Angle Strip by a $1\frac{1}{2}" \times \frac{1}{2}"$ Double Angle Strip. The boiler is secured to the Sector Plate by means of $\frac{3}{8}$" Bolts, but is spaced from the Plate by a Collar on the shank of each Bolt. Three $2\frac{1}{2}" \times \frac{1}{2}"$ Double Angle Strips are bolted together to form the chimney and are fixed to the upper Strip of the boiler. Two $1\frac{1}{2}$" Strips form journals for the dummy crankshaft, and a $\frac{3}{4}$" Flanged Wheel on one end of this is connected by a rubber Driving Band to a $\frac{1}{2}$" Pulley on the dummy dynamo. This is represented by a Double Bracket that is bolted to the front lug of the Double Bracket forming the cylinder.

The model is steered from a 1" Pulley on a $3\frac{1}{2}$" Axle Rod that is journalled in a Reversed Angle Bracket and the lower Sector Plate. The lower end of the Rod carries $\frac{3}{4}$" Flanged Wheels, and a length of cord is wound twice round these and tied to the Double Angle Strip carrying the front axle.

Parts required for Steam Wagon: 2 of No. 2; 2 of No. 3; 11 of No. 5; 2 of No. 6a; 2 of No. 10; 2 of No. 11; 10 of No. 12; 1 of No. 15b; 2 of No. 16; 2 of No. 17; 1 of No. 18a; 2 of No. 19b; 4 of No. 20b; 1 of No. 22; 1 of No. 22a; 1 of No. 23; 1 of No. 24; 4 of No. 35; 55 of No. 37; 5 of No. 37a; 8 of No. 38; 1 of No. 40; 1 of No. 45; 1 of No. 48; 7 of No. 48a; 1 of No. 51; 1 of No. 52; 2 of No. 54a; 4 of No. 59; 2 of No. 90a; 4 of No. 111c; 1 of No. 125; 2 of No. 126a; 1 of No. 186; 2 of No. 187; 1 of No. 190; 2 of No. 195. (*Cont. on page 94*)

Scenic Displays for Exhibitions

Clubs are now in the midst of the work of the second winter session and in many of them preparations are well advanced for the Exhibition that brings this session to an end. An Exhibition held at that time forms a splendid climax to the work of the indoor season, and gives excellent opportunities for the presentation of awards and prizes. It is always a happy affair, for most of the visitors are parents and friends of members, and these are delighted with the results of evenings spent at club meetings, and admire the resource and energy that go to the making of a typical Meccano club Exhibition.

In view of the publicity now given to these displays, it is important that there should be no hitches. Everything must be carefully planned in advance and steps taken to exhibit models and other club work as effectively as possible. It is of little use to introduce critical visitors to a mere array of models of various sizes arranged without discrimination, however admirable the models themselves may be. To-day more is expected from a Meccano club than this. As far as possible a definite model-building scheme should be adopted and the models should be placed in some appropriate setting. Dock and pithead scenes, workshops, carnivals and other displays have been arranged with considerable success in many Meccano clubs. Similar schemes can be based on local industries, or will be suggested by careful reading of the reports on the "Club Notes" pages of the *"M.M."*, and I shall always be glad to help officials of clubs who wish to show the work of their members to the best advantage.

Visitors greatly appreciate displays of this kind, and gain from them a far higher opinion of club work because they realise that this is something more than a mere amusement. Members also derive more satisfaction from their Exhibition, and the models they contribute to it can be treated as competition entries as readily as if no scenic surroundings were employed.

Ordering Models from Headquarters

I strongly urge the inclusion in every club Exhibition of one or more of the models that may be obtained on loan from Headquarters, for these are examples of the highest class of Meccano workmanship that will inspire members themselves and impress visitors. A revised list of models was introduced a short time ago, and I shall be very pleased to send a copy of this to any Leader or secretary who has not yet received one.

There is one point in connection with these models to which I wish to draw attention. Every model sent out is specially built and tested and at least five weeks' notice therefore is desirable. Delay also can be avoided by giving details of the electric current supply available when ordering a model.

Merit Medallions

This month I publish my usual list of Merit Medallions awarded during the past year. It is always a proud moment in a Meccano boy's life when he receives one of these Medallions, especially when it is presented to him with some formality at an Exhibition or concert, and I should like Leaders to make greater use of them than at present. The Meccano boy does not need any artificial stimulus to make him do his best on behalf of the club of which he is a member, but it is only right that enthusiasm, skill and energy should be recognised.

Two Merit Medallions are available each session in each club, and the award is made entirely on the recommendation of the Leader. There is no restriction in regard to the character of the work for which they are given, provided that it has been beneficial in some way to the club, and to the Meccano Guild generally. In some cases efficient work in an official position has been the basis of the award. In others excellence in model-building, in devising schemes for the club programme, or in strengthening the position of the club by attracting new members has earned the Merit Medallion for certain members, and I shall look forward to receiving as soon as possible the nominations of Leaders who wish to reward good work on behalf of their clubs carried out during the present session.

Merit Medallions Awarded in 1934

BARTON-ON-HUMBER—H. Steele. BEXLEYHEATH—D. Choppen, F. Grout. CHERTSEY—R. J. Burtenshaw. CHESTERFIELD (Mary Swanwick)—F. Haywood, G. Loomes, C. Knopp, R. Alexander. COLWYN BAY—H. Thomas, V. Chaplin. DAGENHAM—R. V. Stokes, D. King, G. Chorley, A. McBain, L. W. Grubb, G. Fearn, V. Cooper, V. Bennett, P. Jennings. EDINBURGH (St. Giles' Cathedral)—A. Mathieson, H. Govan. EXETER—D. Wills, H. Adams, J. Goss, E. Elworthy, R. Whelan, G. Southard, R. Hodge, R. H. Beckett. GLASGOW (Morison Memorial)—W. Omnet, T. Shearer. HARWICH—R. Marsh, P. Stevens, W. Ainger. HEREFORD—S. Wood. HEYWOOD (Regent Street Selective School)—W. Turner. LONDON (Holy Trinity, Barnsbury)—A. Shaw, K. Dines, G. French, R. Hancock, H. Fairey, P. Gilroy, E. Hancock, N. Thompson. (Millwall Central School)—A. Newman, N. Butler. (Old Charlton)—W. Jacques, J. Freeman. MAIDSTONE (Sutton Valence)—E. Metcalf. MIDDLESBROUGH—H. Richardson, R. Lunnon, L. Weighell, A. Lambert. PLYMOUTH—S. T. J. Brenton, P. C. Frizzell. SEVENOAKS (St. Nicholas)—L. Marshall. SIDMOUTH (Sid Vale)—B. Poulton, J. Broom.

OVERSEAS CLUB MEMBERS

CANADA (St. Clair Y.M.C.A.)—J. Feckter, G. Bell. FRANCE (Mulhouse)—V. Gerhart, A. Creuzard. HOLLAND (Maastricht)—P. M. E. Bingen. ITALY (Milan)—G. Previati, A. Sacchi. NEW ZEALAND (Ashburton)— E. Osborne, N. Dunn. (Wellington Boys' Institute)—E. H. Speers, R. J. Southwick, A. Abel. SOUTH AFRICA (Berea)—R. Metter, C. Blackbeard. (Malvern)—H. Brown, C. Robert, Peggy Dall.

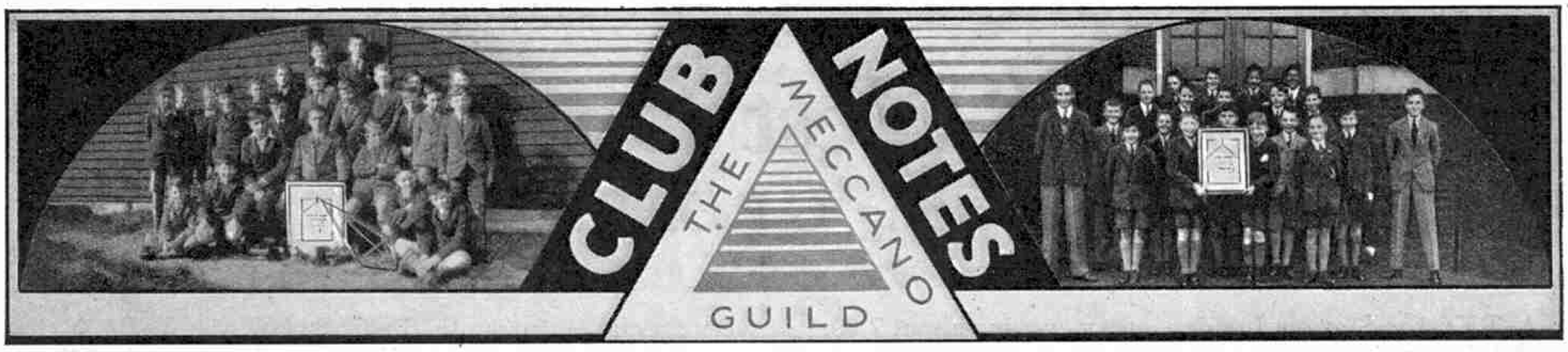
Notices of Coming Events

Another point I should like Leaders to keep in mind is the desirability of informing me as early as possible of coming Exhibitions. This will enable me to include announcements on this page that will be helpful in attracting visitors. On several occasions notices of this kind have led to the acquisition of keen Meccano enthusiasts as new members. The *"M.M."* goes to press early, and notices therefore should be sent to me at least a month in advance of the date of publication, but I can still include notices of Exhibitions in March in the next issue if I receive details within the next few days.

Proposed Clubs

Attempts are being made to establish Meccano Clubs in the following places, and boys interested in becoming members should communicate with the promoters, whose names and addresses are given below:

BUCKLEY—Master F. Keighley, 192, Mold Road.
CLAPTON—Mr. H. Galpin, 23, Blurton Road, E.5.
LANGLEY—Master F. Sillitoe, 11, High Street.
NEWTOWNARDS—Master J. Getty, Hillcrest.
SEDBERGH—Master J. G. Boardley, The Preparatory School.
STAFFORD—Master D. Griffiths, 12, Cull Avenue, Littleworth.
WALSALL—Master P. Goally, 11, Guild Avenue, Leamore.



Whitstable M.C.—Membership is increasing and the club is growing stronger. Meetings are held in a room kindly placed at the disposal of members by Mr. H. W. Dixon, and open on Wednesdays from 4 p.m. onward. Model-building has been varied by operations on the club's excellent Hornby Railway, and Games Evenings. The Billiard Table is very popular and members are interested in competitions of all types. Club roll: 25. *Secretary:* L. Dale, "Maycott," 77, Albert Street, Whitstable.

John Gulson Senior Boys' School (Coventry) M.C.—Members are becoming very skilful model-builders, excellent rocket cars, steam wagons and motor cars having been among models built at home and brought to meetings for discussion and the award of marks. An excellent display was made with them at the Annual Visitors' Day at the School, at which a Hornby Train layout also attracted great interest. Games Nights, Joke Nights and Competition Nights are held regularly. Club roll: 14. *Secretary:* T. Chappell, "Kinbrae," 8, Troughton Crescent, Radford, Coventry.

Macclesfield Grammar School M.C.—A model of a scenic railway has been built by a group of members, and other models prepared for the club's Exhibition included a Marine Engine, a Travelling Gantry Crane and a Grandfather Clock. Model-building meetings continue to be held weekly, and recently additional meetings have been devoted to engineering lectures and to special activities. The club library is growing rapidly and members make great use of copies of the "*M.M.*" included in it. Club roll: 15. *Secretary:* D. Warburton, 57, Church Street, Marple, Nr. Stockport.

St. James' (Grimsby) M.C.—A model of a Baltic Tank has been built by members, who have been greatly interested in the construction of the sections and their assembly. The necessary Meccano parts are club property, having been purchased with club funds, and will be available for the construction of similar large models. Other activities have included interesting visits to the local gas works and the flour mills of Spillers Ltd. Club roll 8. *Secretary:* E. David, Carwright, 36, Wellowgate, Grimsby.

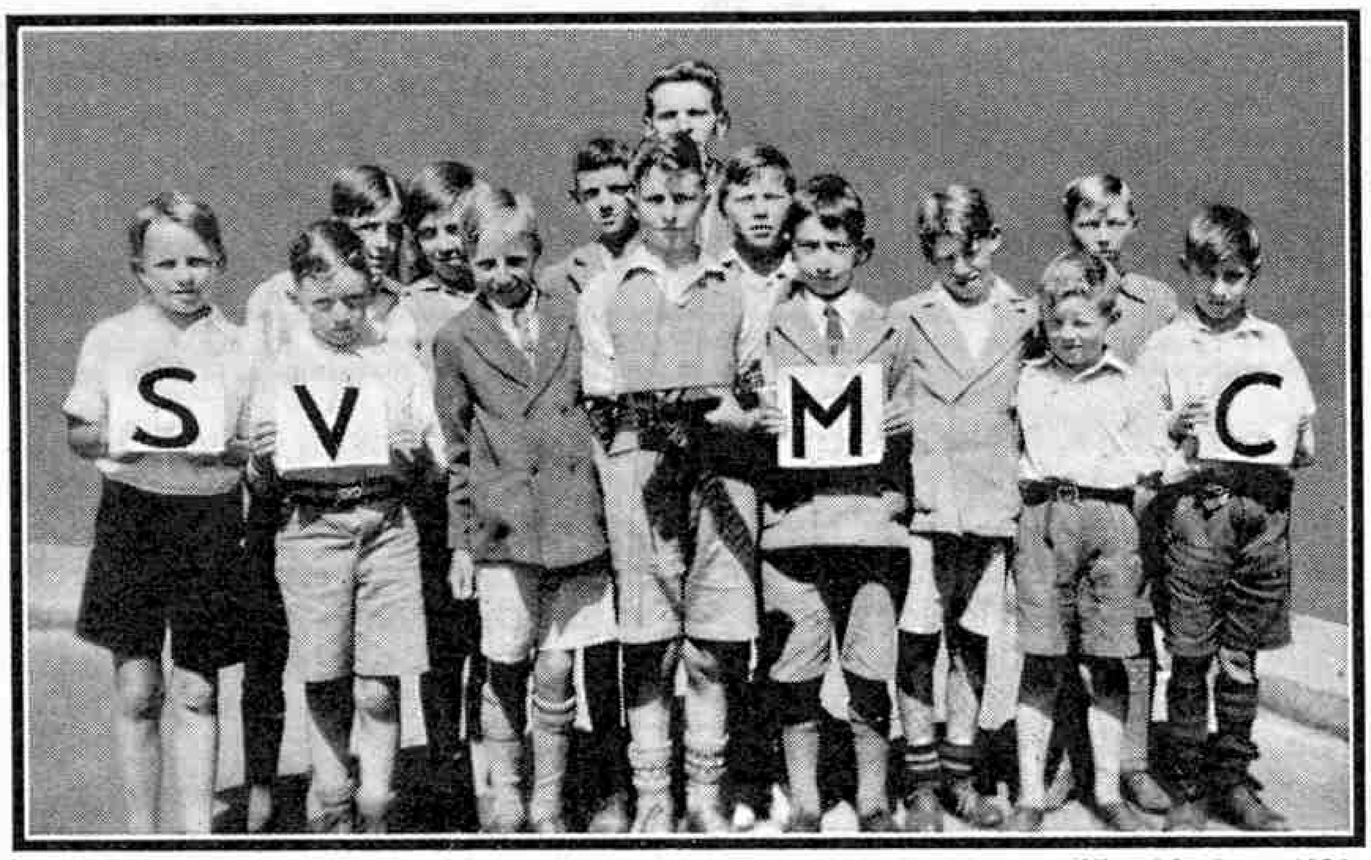
Glendale College (Westcliff-on-Sea) M.C.—The club became active when school was resumed in autumn and meetings for model-building have been held weekly. "*The Cog*," the club's magazine, continues to be successful, and is to be enlarged and published monthly. The earlier numbers were small, but full of interest and a convenient source of club news. In its new form the magazine will be much more useful. Club roll: 31. *Secretary:* D. Lake, Glendale College, Crowstone Road, Westcliff-on-Sea.

St. John's School (Bridgwater) M.C.—The design and construction of Meccano model games provided interesting occupation for members, and the games themselves proved a useful source of revenue at a Sale of Work. A demonstration of work on the club lathe was given by Mr. C. H. Sanderson, Leader, and members then built model lathes of various types. Electrical Experiments and Debates were other attractions at meetings. Club roll: 15. *Secretary:* L. R. Temple, 46, Monmouth Street, Bridgwater.

Balham Grammar School M.C.—Models showing remarkable originality and constructional skill were entered in an Aeroplane Building Contest, and an equally high standard has been reached in other competitions. An interesting feature is "Meccano Products Night," when members bring speed boats, aeroplanes or any other products of Meccano Ltd. and arrange demonstrations or experiments. Hornby Train Nights and Games Evenings provide variety. An excellent impression was made by the work of members when displayed at a Hobbies Exhibition held at the school. Excursions are arranged on Saturdays, those enjoyed so far including visits to Tilbury Docks and the Croydon Air Port. *Leader:* Mr. L. R. Sharpe, Balham Grammar School, High Road, London, S.W.17.

Sid Vale M.C.—The excellent series of Model-building Contests continues and members show great keenness and originality. A "Model Illuminated Carnival" was a novel event. Tableaus were mounted on motor lorries constructed in previous contests, and these were paraded round the room at an Open Meeting at which many parents and friends were present. The winning tableau in the Senior Section represented an old world garden, and the "Babes in the Wood" was the subject of the first prize-winning effort in the Junior Section. An enjoyable evening was spent at a club Party, which formed the official opening for the session. Club roll: 25. *Secretary:* R. Gliddon, Sheffield House, Sidmouth.

Bridport Grammar School M.C.—Excellent progress is being made and there is a satisfactory increase in the club's funds, which are to be devoted to providing prizes in frequent Model-building Contests, and to additions to the Library. An excellent Lantern Lecture was arranged in conjunction with the school Natural History club. The subject was "*Lumbering in Canada*," and the lecturer was Mr. T. J. Taylor, a member of the school staff. Club roll: 29. *Secretary:* H. M. Dommett, West Allington, Bridport, Dorset.



A group of members of the Sutton Valence Council School M.C. This club was affiliated in June, 1934, and under the skilful guidance of Mr. A. G. Freeman, Leader, has followed an attractive programme of Model-building, Lectures, Visits to works and Excursions, and talks on scientific and engineering subjects, with experimental illustrations. The good work done has earned the commendation of the school managers, one of whom, Mr. C. R. Boswell, has kindly accepted the Presidency of the club.

Plymouth M.C.—The club's Annual Exhibition was a wonderful success and members paid tribute to the ingenuity and skill of the organiser, Mr. W. J. Ellis, Leader of the club. In addition to Meccano models and an Electric Hornby Railway, there was a model railway, for which scenery was constructed by members, and a complete layout of Plymouth's tramways, which attracted special notice from visitors. The subject of a novel model-building meeting was "*Prehistoric Animals*." Many amusing models were shown, and some of the creatures were so ingeniously designed that the removal of a few nuts and bolts converted them into others of even more startling appearance. A Printing Section has been formed, and it is hoped that the members of this will be able to produce the "*Gear Box*," the club magazine. Club roll: 70. *Secretary:* P. Frizzell, 85, Beacon Park Road, Swilly, Plymouth.

St. Giles' Cathedral (Edinburgh) M.C.—Recent meetings have been the most successful in the club's history, and there have been record attendances. Good progress is being made with the reconstruction of the club's Hornby Railway, and plans for semi-automatic electric signalling are being discussed. A club Canteen has been started. Members are showing a greater inclination for what the secretary calls "pugilistic games," but so far there have been no ill effects, except an occasional black eye! A series of talks on "*Well-Known Edinburgh Schools*" is being given by the Leader and Cinematograph Shows are now held monthly. Club roll: 146. *Secretary:* H. W. Govan, 25, South Orchard Road, Edinburgh, 4.

Ipswich M.C.—A remarkably successful Exhibition was held shortly before Christmas. The models were arranged in admirable scenes, and special interest was taken in a working electric advertising sign carrying the words "*Ipswich Meccano Club*." A Shooting Gallery was well patronised and Jig-Saw Puzzles made by members sold readily. An aerodrome scene with models of aeroplanes added variety to the display. About 300 visitors expressed their appreciation of the work of members. Club roll: 12. *Leader:* Mr. W. Sheppard, Chancery Road, Princes Street, Ipswich.

Claremont Avenue School (Harrow) M.C.—Four groups have been formed for competitions in Model-building and Games, and a prize is to be awarded to the winning group in each series of contests. Hornby Nights have been held in addition to Model-building Evenings and Games, Cinematograph Exhibitions and talks on Photography have been included in the programme. Club roll: 16. *Secretary:* S. J. Biggs, 20, Cranleigh Gardens, Kenton, Harrow.

Bexleyheath Boys' Central School M.C.—An interesting feature of recent work was the construction of a Training Aeroplane and demonstrations with it. A Lecture on "*Motor Cars*" was given by the secretary and talks on aquaria and similar subjects of interest are being arranged. The "*Gear Wheel*," the club's magazine, continues to be successful. Club roll: 35. *Secretary:* F. Grout, 57, Nursery Avenue, Bexleyheath, Kent.

AUSTRALIA

Melbourne M.C.—An excellent Meccano flashing sign for advertisement purposes has been built by one member. Others have made sign posts and gradient posts for use with the railway layout. In a special contest, members were allowed 30 minutes to name the contents of a bottle containing Meccano parts, and 27 out of the 41 parts included were correctly identified by the winner in the time. A visit of special interest was paid to the Annual Display of the Engineering School of Melbourne University, where members tried their strength in pulling objects off powerful electro-magnets, but showed hesitation when asked to try a powerful shocking machine! Club roll: 12. *Secretary:* L. Ison, 8, Hayes Street, Northcote, N.16, Victoria, Australia.

CANADA

Edmonton Y.M.C.A. M.C.—A Meccano sign constructed by two of the members now hangs in the Y.M.C.A. Common Room and it is hoped will attract recruits. There is keen competition in Model-building Contests in which members construct entries at home for judging at meetings. Other events have included a Conjuring Exhibition, a talk on "*Physics*" by Mr. E. Jordan, Leader, and visits to engineering and industrial plants. The extent and variety of the programme has ensured a very successful session. Club roll: 14. *Secretary:* J. Hargreaves, 12031-96 Street, Edmonton, Alberta, Canada.

Toronto Central Y.M.C.A. M.C.—The grant of affiliation has been received with great enthusiasm and there seems to be a bright future for the club. Members were asked by the Y.M.C.A. to give a special display and quickly built a series of large models that attracted favourable comments from visitors. Model-Building Evenings and novel Contests are the chief features of the programme. A paper on "*Railway Signalling*" was greatly enjoyed by members, who are now planning a Hornby Train layout. Club roll: 12. *Secretary:* B. Moore, 141, Albertus Avenue, Toronto, 12, Canada.

NEW ZEALAND

Christchurch M.C.—The club's fifth Birthday was celebrated with a Social, at which there was a large attendance of parents and friends. Members of the Ashburton M.C. also were present. A display of models and a Hornby Train layout were on view, and Games, Competitions and Supper helped to make a happy evening. Cycle runs have been arranged and a return visit paid to the Ashburton M.C. A talk on "*The Production of a Newspaper*" was given by Mr. Staples. Club roll: 26. *Secretary:* L. W. Best, 28, Circuit Street, Elmwood, Christchurch, New Zealand.

A Model "West Coast Postal"

Interesting G.P.O. Exhibit

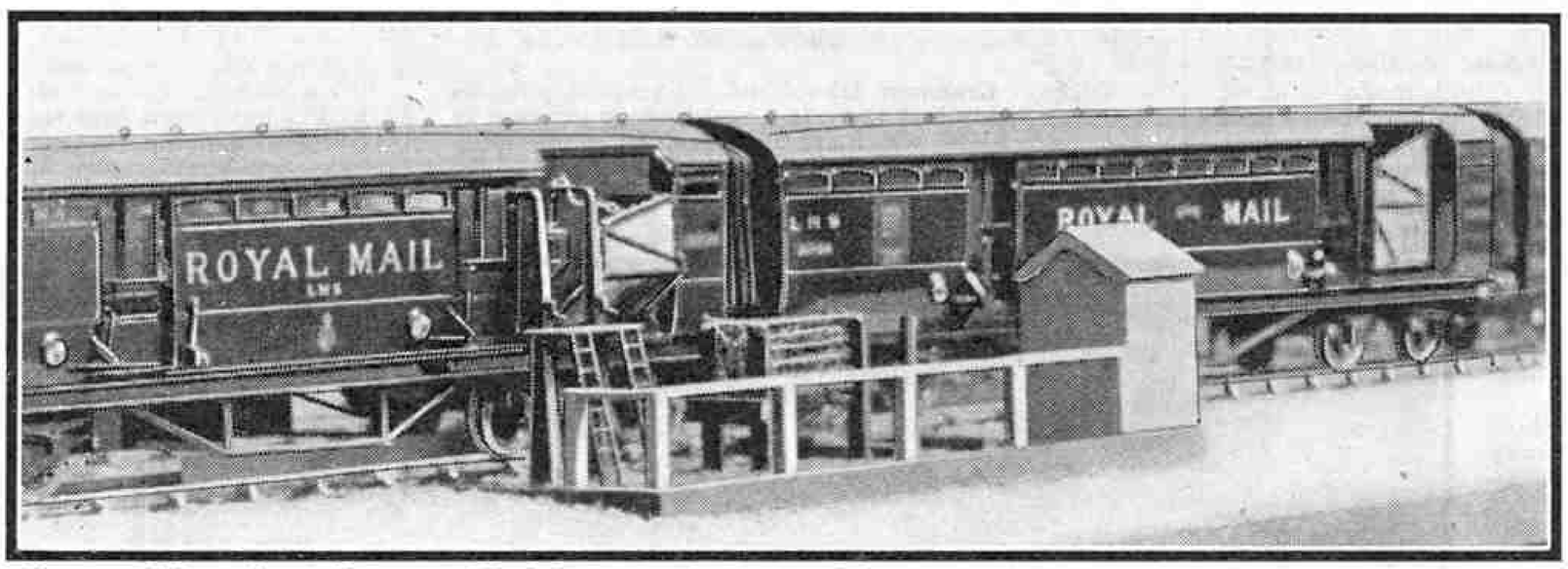
AT Euston Station, London, every evening about 7.30, bright red Post Office Vans begin to arrive with bags of mails for the well-known 8.30 p.m. "down special" postal train from Euston to Aberdeen. This travelling post office is made up of baggage vans, stowage vans and postal sorting vans with pick-up apparatus, and is usually hauled by a "Royal Scot" type locomotive.

Recently the Public Relations Department of the General Post Office decided to make this famous mail train the basis for a large working model showing the operation of the "Travelling Post Office." The designing and making of the model was entrusted to Bassett-Lowke Ltd., of Northampton, who for years have made high-class exhibition models one of their specialities.

The exhibit was laid out on a table 120 ft. long, and consisted of $1\frac{3}{4}$-in. gauge railway track, with double road and loops at each end, arranged for continuous running. Practically the whole of one of the 12 ft. diameter loops was in the form of a hill tunnel, giving scope for artistic scenic effects, grass, trees and hedges, which were carried out over the whole of the model and gave it a very realistic appearance. The centre of the track was occupied by a modern design main line station representing reinforced concrete, the booking office being surmounted by a clock tower. The station was complete with book-stall, waiting room, station-master's office, station seats, etc., and was decorated with scale reproductions of railway posters. It also contained such distinguished passengers as George Bernard Shaw, Lloyd George, Ramsay MacDonald and Charlie Chaplin!

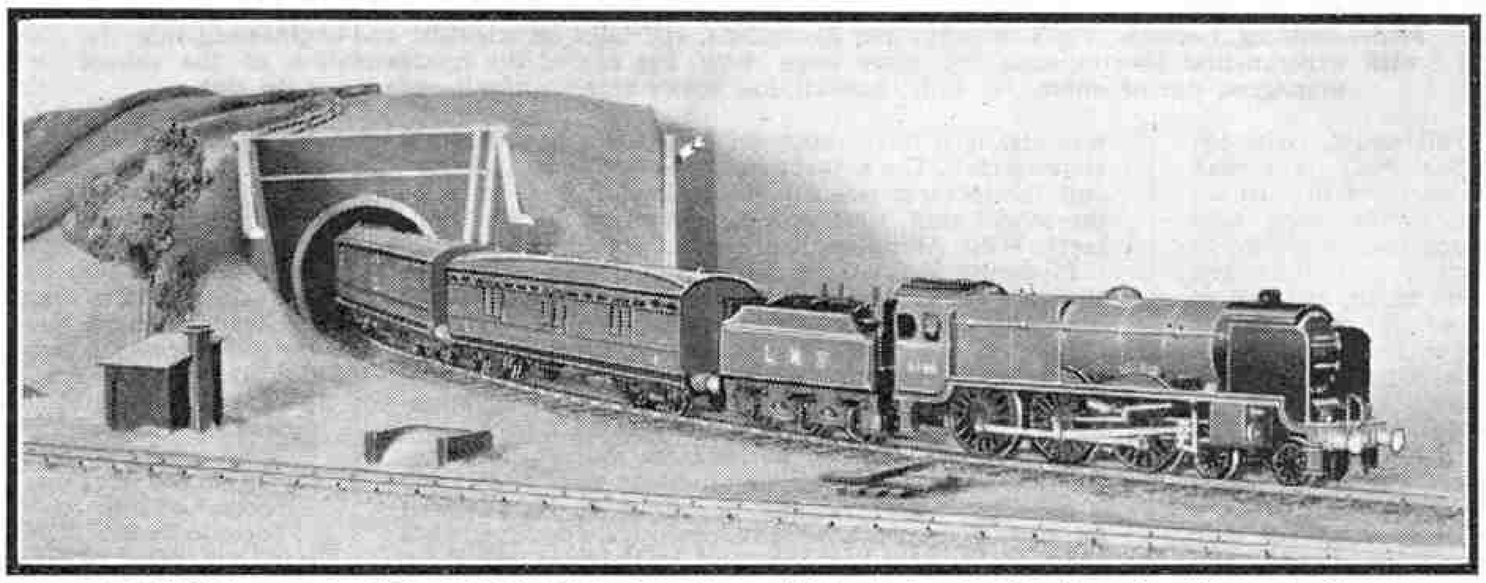
Scale model wayside pick-up apparatus was fitted at two positions along the track, enabling the model pouches or mail bags to be delivered and collected while the train was travelling at full speed. This operation was very skilfully reproduced in miniature, even to the ringing of the bell as in real railway practice.

From the model point of view the exhibit had several very special features. In the first place the whole of the locomotives, rolling stock, signals and railway buildings were made to the exact scale of 10 mm. to the foot and track was of the standard gauge of $1\frac{3}{4}$ in. The two locomotives provided, one as a reserve in case of running trouble, were the *"Royal Scot,"* No. 6100, and the *"Black Watch,"* No. 6102, of the L.M.S. Railway. Every external detail on these locomotives and the vehicles hauled was faithfully reproduced to scale, and the train in use is operated electrically by means of the third rail system supplied with current at a voltage of 20.



Close-up of the train passing a wayside pick-up, showing the model apparatus in operation, the net opening out to pick up the bag of mails as the train passes. This model was built by Bassett-Lowke Ltd., of Northampton, to whom we are indebted for our photographs.

The electric motors in the models were of special construction, made for long and continuous running. The magnets were of special cobalt chrome steel of exceptional strength, with 8-pole armatures with their steel shafts running in ball bearings. The collectors were of heavy gun-metal, arranged so that the shoes, which wear out quickly with constant wear, could be easily replaced. The gearing was worm and wheel type, the steel worm driving a bronze worm wheel in a gearing ratio of 20 : 1. The motor brush gear was of a special type with copper carbon brushes and brake section, which is easily renewable. The commutator was of phosphor bronze. The lubrication of the motors was a special feature. Small tubes were laid to each of the parts needing lubrication, and these were carried into a receptacle in the dome, so that the motor could therefore be properly oiled from the outside through a small hole in the dome. The control and operation of the model was from a signal-box near the station, where the controller and resistance were housed. The signals were of standard upper quadrant pattern.



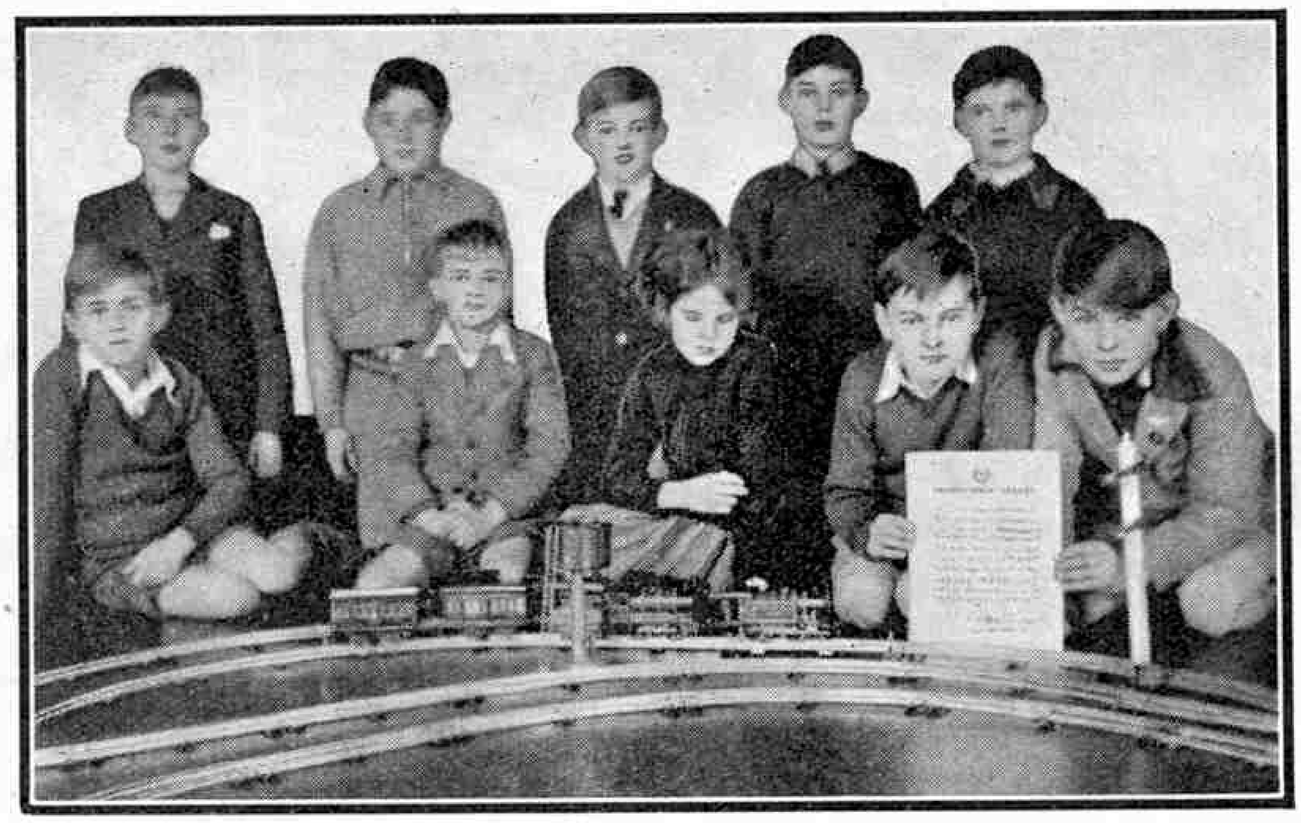
L.M.S.R. locomotive "Black Watch" hauling the postal train, leaving the tunnel on the main line.

The attractive model was first seen at "Radiolympia," and during the short period of the exhibition the locomotives ran a distance of 125 actual miles. The model is to be seen in various parts of the country during the next few months.

Branch News

KILMAURS.—Very interesting meetings are being held, largely as a result of a discussion on weak points of previous sessions. The track has been rebuilt, new materials being introduced where necessary, and members enjoy meetings so much that they are invariably surprised when closing time comes. Games Nights also are a great attraction. An excellent Lantern Lecture on *"Britain's Largest Railway"* has been given, slides being kindly loaned by the L.M.S.R. Secretary: J. Marshall, 52, Main Street, Kilmaurs, Kilmarnock, Ayrshire.

ADDISCOMBE.—A special meeting was held to celebrate incorporation, and members greatly enjoyed railway competitions arranged for it. Special talks on *"The Romney, Hythe and Dymchurch Railway," "The Cheltenham Flyer"* and other railway topics are given regularly by members. Railway trips on interesting lines are a special feature of Branch proceedings. A Cinematograph Film illustrating French railway operation has been given, and last session concluded with a Christmas Entertainment at which prizes were presented. Secretary: G. Chandler, 62, Ashburton Avenue, Addiscombe, Croydon, Surrey.



Members of the St. Christopher Junior School (Letchworth) Branch, No. 205. Chairman: Mr. C. B. Ogilvie; Secretary: G. Morris. Interesting layouts are used at track meetings, and pointsmen are provided with diagrams of their own sections of the line to ensure accurate working and avoid accidents. This plan has led to the development of excellent train control.

BELFORT (CATFORD).—Members continue to hold meetings, in spite of the difficulties caused by not having a regular meeting place. More members are required and the secretary would be pleased to hear from Hornby Railway enthusiasts who would like to join, and also from anyone who can help the Branch to secure a permanent home. Secretary: F. B. Graves, 133, Bromley Road, Catford, London, S.E.6.

CAMPDEN GRAMMAR SCHOOL.—An excellent track has been laid down and provided with scenery executed by a member of the Branch. Meetings are held regularly on Saturdays and pupils at the school are invited to watch operations. Constructional work also is carried on and special attention is being given to the making of electric colour light signals. Secretary: E. R. Ridgway, The Grammar School, Campden, Glos.

TERRINGTON HALL.—Great enthusiasm was shown when incorporation was granted. A splendid track has been laid down in the Branch room and this was officially opened, and the first train despatched, by Mrs. Littlewood, wife of Mr. T. B. Littlewood, President. The Branch track now represents the L.M.S.R. line between Crewe and Liverpool, and the inclusion of a dockyard provided with a Meccano crane adds greatly to the opportunities for interesting working. Secretary: J. M. Hutchinson, Maiden Hill, Penrith, Cumberland.

HOLLANDERS.—Steady progress has been made with the development of the track, to which sidings and electric signals have been added. Locomotive tests for speed and pulling power were followed by the operation of goods and passenger services and these are now arranged regularly at track meetings. The track is double throughout and is well maintained, tests being continually applied in order to ensure smooth running. Secretary: R. Sparling, 4, Gore Lane, Spalding.

WHITGIFT SCHOOL.—Members are concentrating on accurate timetable working. The locomotives available were thoroughly tested in order to enable each to be assigned to suitable working and a timetable founded on their performances was drawn up. Shunting problems to be solved on the club track form attractive competitions. Visits have been paid to the works of the Quasi-Arc Co. Ltd. and Kodak Ltd. Secretary: J. A. Watson, 23, Addiscombe Avenue, Croydon.

ST. SAVIOUR'S (RAYNES PARK).—Track operations form the chief attraction. Timetables are carefully revised from time to time to suit traffic, and good use is made of signals and rolling stock constructed by members for Branch use. Interesting Lantern Lectures have been given by Mr. Willoughby, Chairman, and films are shown regularly by members of the Branch. Secretary: A. Wakefield, 39, Elm Walk, Raynes Park, London, S.W.20.

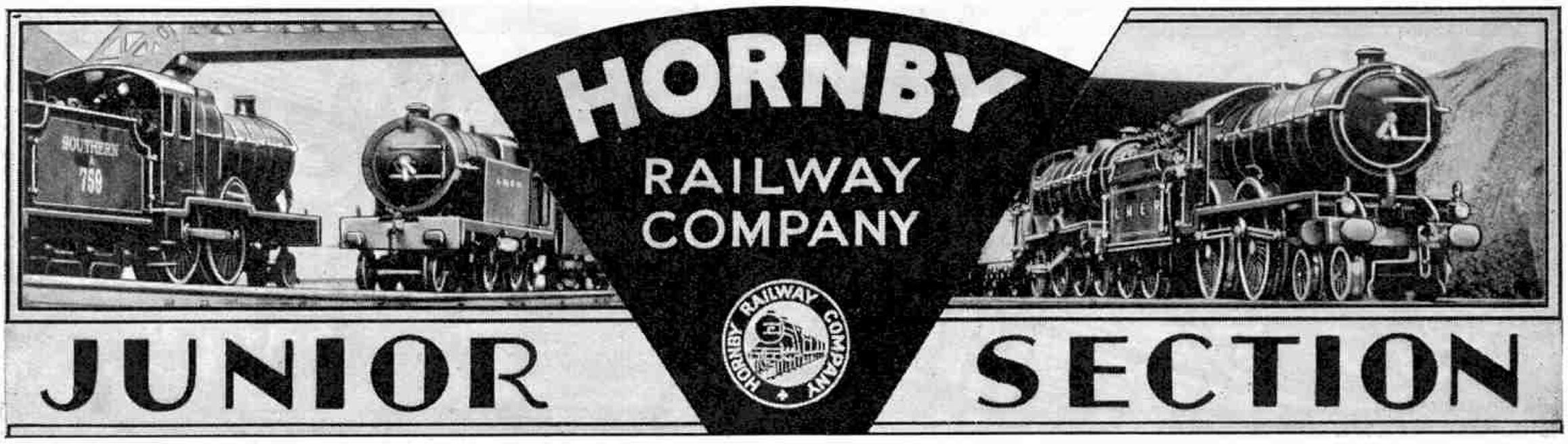
CATERHAM SCHOOL.—Special interest has been taken in a series of Lantern Lectures on *"Types of Locomotives"* and other railway subjects by Mr. H. F. Wilmut, Chairman, and other officials. The track is now Branch property, thanks to the kindness of one of the members, and therefore is not liable to be altered or reduced. Better working on well planned lines is possible, and more rails are to be purchased. Secretary: J. D. Andrews, Brightling, Fir Tree Road, Banstead, Surrey.

MAIDSTONE.—A Branch room has now been secured and an excellent Branch track laid down permanently. A workshop also has been fitted up to enable members to carry out repairs and do constructional work. New members are required to show proof of interest and industry before admission. In an interesting Photographic Contest held recently there were classes for photographs of stationary and moving locomotives, and of general engineering interest. A talk has been given by Mr. W. H. Evernden on his experiences as a model locomotive driver during last summer. Secretary: W. Hills, 29, Union Street, Maidstone.

AUSTRALIA

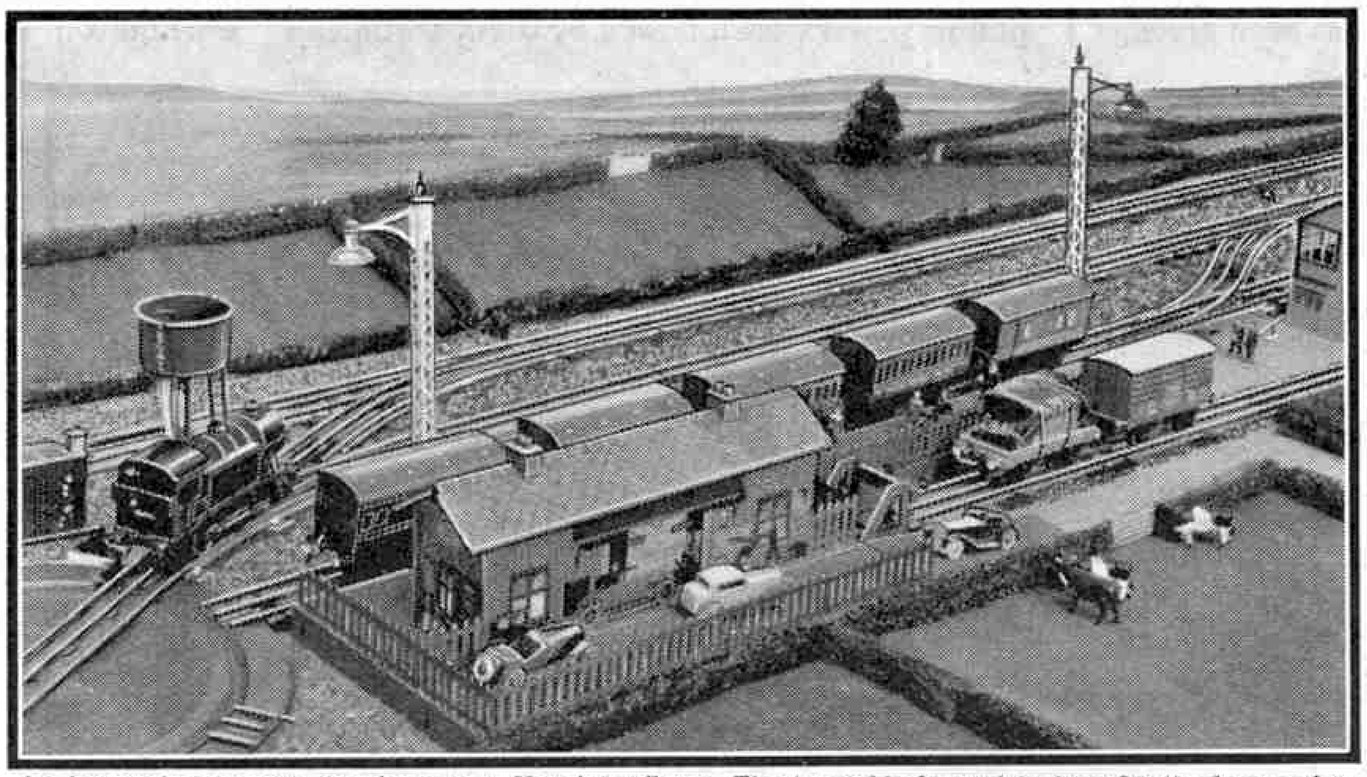
PARRAMATTA.—The Branch layout has been considerably extended and improved by the provision of a large terminus with an interesting layout that has been accurately signalled. The signals are correctly interlocked and very realistic working is possible as a result of the care devoted to the design of the main track and the necessary sidings. Equally careful work is being carried out on the second terminus and intermediate stations, and steady running and attractive operations are being enjoyed. Chairman: Mr. H. H. Matthews, 27, Ross Street, Parramatta, N.S.W., Australia.

PERTH (WESTERN AUSTRALIA).—The Branch layout is being extended further, and the track is now planned on a large scale. The rails are well ballasted and splendid running is obtained at track meetings. Scenery and lineside effects are now being given attention. The appearance of the track has been greatly improved and the realism of operations increased by this work. Secretary: J. Stanbridge, 285, Lord Street, Perth, Western Australia.



SIDINGS AND REVERSING LOOPS

WHEN a layout is being developed from the "plain circle and oval" stage, the miniature railway engineer invariably introduces points in order to increase the scope of operations. The line becomes more realistic as a result, and the attempt is invariably made to introduce branch lines, sidings and loop lines such as are commonly seen in actual practice. There are various methods of laying out these different track formations, and every Hornby railway owner will adopt whatever method suits his layout. Whatever the scheme adopted, it is essential to realise the possibilities or limitations of the different siding schemes themselves, and in this article we propose to consider several different arrangements and their various advantages on a Hornby layout.



An interesting country terminus on a Hornby railway. The turntable is used to transfer the locomotive to the loop line on which it runs round its train.

On a plain continuous oval track, difficulty soon arises from the fact that there is no suitable place for the storage of rolling stock. For instance, there is nowhere to leave the goods vehicles while a passenger train is being run. One siding at least is necessary for this purpose, and the simplest way of arranging this is shown in the first diagram of the series illustrated on the opposite page. Points are introduced into the main line, and as the curved portion of these corresponds to an ordinary curved rail in length and radius, it is only necessary to add a single curved rail to make the siding line parallel to the main line. The length of the siding will be governed by conditions, but in calculating the number of rails required allowance must be made for the buffer stops, which should be used to terminate any dead-end siding of this kind. The No. 1 Buffer Stops is the most suitable for an ordinary siding line and this is equal in length to a straight quarter rail. A dead-end siding of this kind is useful for the storage of rolling stock and in forming part of a goods yard, and also as a main line feature where traffic is not heavy.

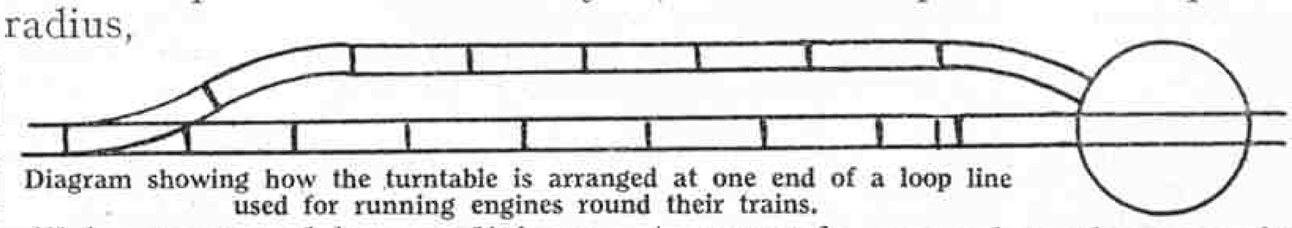


Diagram showing how the turntable is arranged at one end of a loop line used for running engines round their trains.

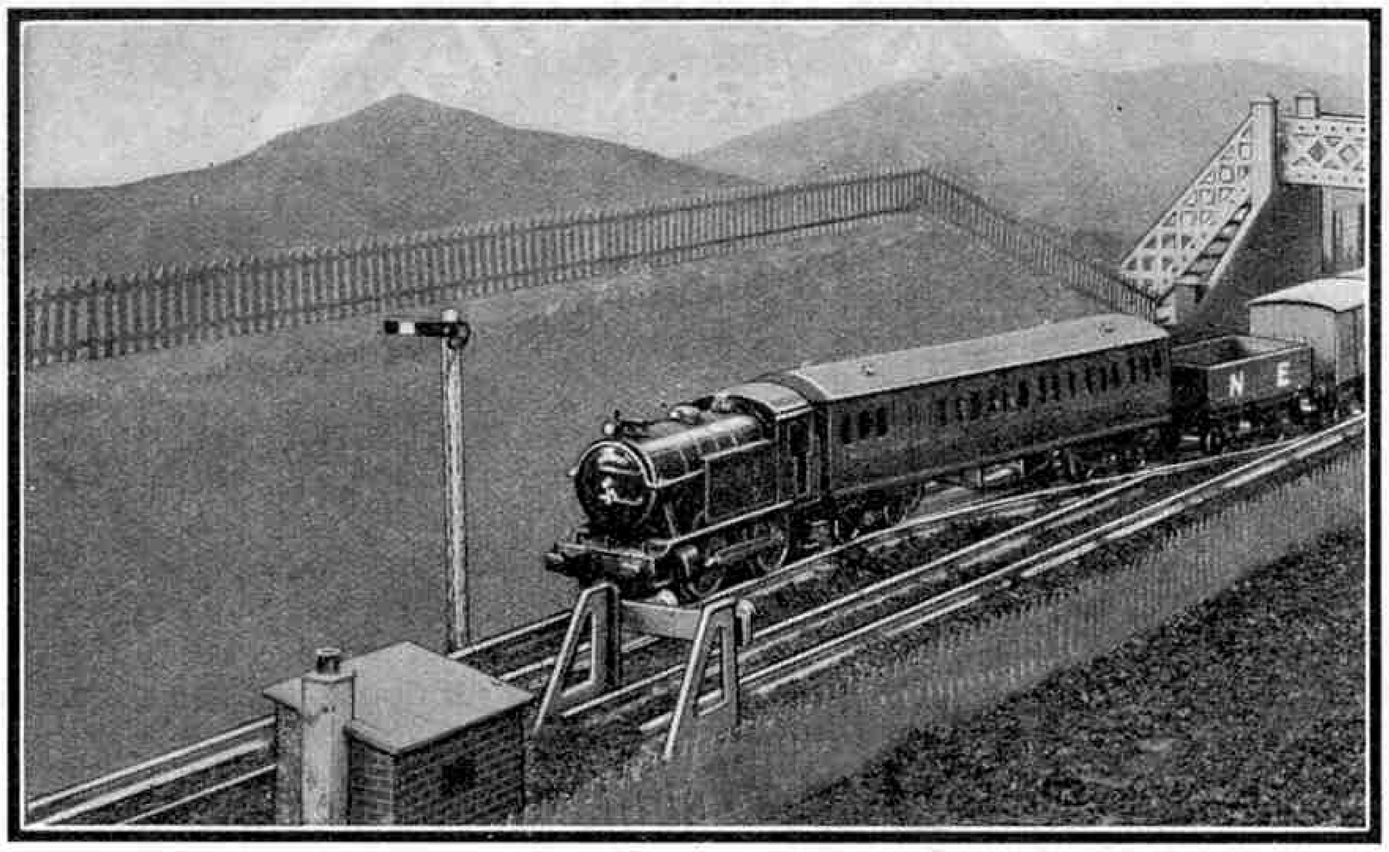
The second arrangement shown is a development of the one just dealt with in that the single curved rail of the first scheme is replaced by a pair of points of the same type as those laid on the main line. This gives the effect of a crossover connection between the main line and the siding. The siding can be extended in both directions, the points coming in approximately halfway along its length as shown in the diagram.

At first it might be thought that this arrangement is hardly likely to be useful on a layout, but within its limits it is really quite a good scheme. It can be used by trains travelling in each direction on the main line, and vehicles can be picked up or detached by these trains as required. For instance, a train on the main line approaching the points in a facing direction, and requiring to detach some wagons, comes to a stand before the points. The engine and the wagons to be detached are then uncoupled from the rest of the train and run into the siding. The points are next set for the straight road of the siding and the engine, having been reversed, backs the wagons down the siding, perhaps up to the buffer stops, where they are out of the way and not likely to interfere with the movement of locomotives or rolling stock between the main line and the siding. The wagons also are in position to be picked up later by a subsequent train travelling in the same direction. If they are to be picked up by a train in the opposite direction, however, they must be moved to the opposite end of the siding. There may be other wagons to be left in the siding at the same time. If these are marshalled at the rear of the train they are shunted in after the wagons to be taken away have been picked up, but if they are next to the engine, they leave the train with it to effect the picking up, and are shunted in afterwards.

The only disadvantage to these two schemes is that a train has to be backed into or out of the siding, according to its direction of travel, each time the siding is used. This is considered to be an irritating process by some

miniature railway owners and it certainly takes time where a long train is involved. Where traffic is frequent this may prove to be a source of delay and in order to avoid this some form of loop line becomes necessary.

Continuous loop lines therefore appear in the next two illustrations in the diagram. The actual method of laying down the loop depends on the circumstances where the loop is required, and on the track material available. Ordinary turn-out points may be used as shown in the third diagram, in which the layout incorporates one left-hand point and one right-hand point. Curved rails are used, as in the first example, to bring the siding track parallel to the main line. The straight length of the siding between the two curved rails bears a fixed relation to the straight length of the main line between the two sets of points. The main line length is always longer than the siding, the difference between the two equalling the length of the two straight rails, one straight half rail and one straight quarter rail. In the diagram, therefore, as the main line section consists of six straight rails, the siding is composed of three full length straight rails and one straight quarter rail in between the two curves.



A mixed train leaving a siding after picking up several wagons. The siding is connected to the main line by means of crossover points and is extended to form a short dead-end.

The loop line thus formed may be employed along the main line of a layout for accommodating a goods train when a passenger train requires to pass it. Such loops also may be laid down at stations to enable trains in opposite directions to pass on a track that otherwise is a single line. Another possible use is as a "run-round" loop at stations to enable the locomotive of an arriving train to be transferred from one end of its train to the other, ready for the return journey.

A neater arrangement that is more in accordance with actual practice is shown in the fourth layout; this involves the use of two crossover points, one left-hand and the other right-hand. The siding between them is of exactly the same length as the corresponding section of the main line and Hornby Double Track therefore can be used with advantage between the crossover points. A feature of interest in this method is that it gives short dead-end extensions of the siding, beyond the switch rails of the crossover points, which in practice are invariably terminated by the buffer stops. Where space permits, these dead-end extensions can usefully be lengthened in a similar manner to that employed in the second scheme.

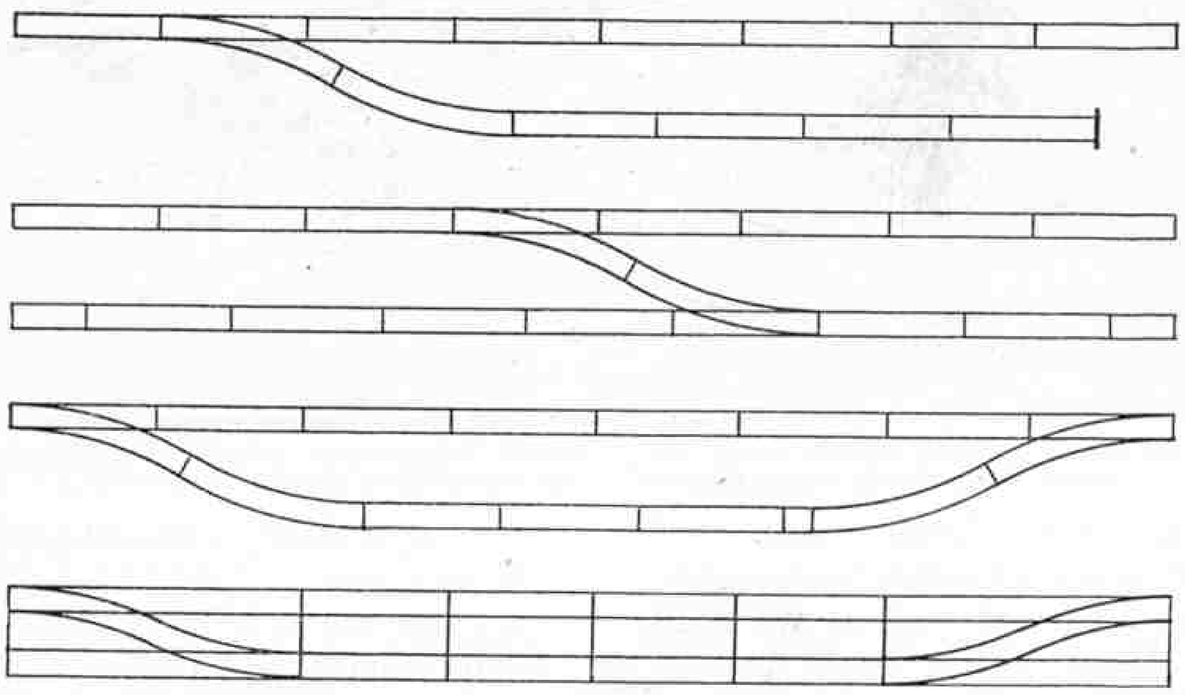


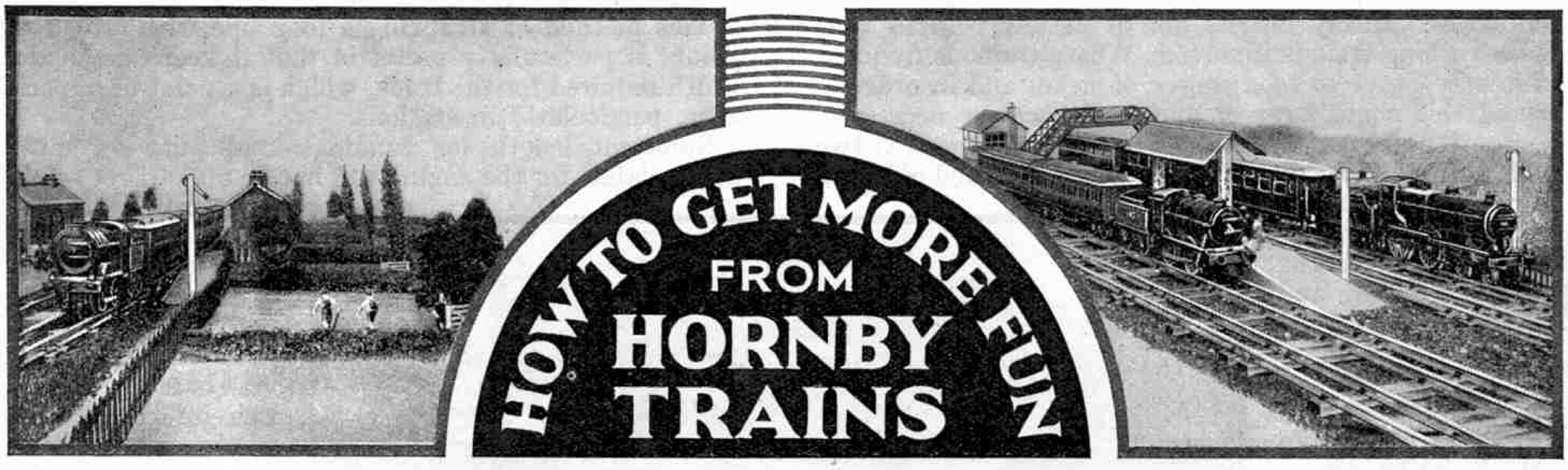
Diagram showing sidings and loops arranged in various ways with ordinary points and with crossover points, as described in this article.

This method of arranging a loop line with crossover points is particularly useful in that it keeps down the width required for the track, which is a point of importance, particularly in stations.

Sufficient length for running-round purposes must be available, for the engine will not be able to get round the train if the coaches cannot be accommodated clear of points at each end of the loop. From the point of view of saving length, therefore, the scheme shown in the diagram on page 120, and illustrated in the photograph on the same page, may be considered. Apart from its merits in saving length, it is an interesting arrangement that is useful in miniature railway practice. It is particularly suitable for terminal stations, but also may be employed as part of the layout of a locomotive yard. It involves the use of the Hornby No. 2 Turntable at one end of the loop, the connection of the loop and the main line at the other end being effected by means of ordinary turn-out points and a curved rail in the usual way.

It will be noticed that the Turntable and its "run-off" lines replace both the straight and the curved branches of the points that ordinarily would be employed, and the use of the Turntable enables an engine to be transferred rapidly from the straight track to the loop line. As there is no need for the engine to proceed beyond the Turntable, the usefulness of the arrangement in restricted parts of a layout as opposed to ordinary points will be appreciated. When used in this manner the Turntable acts as a traverser, in addition to its normal use for turning locomotives. An arriving engine can thus be turned, as required for its return journey, and directed on to the loop road quite easily and quickly by means of this arrangement. The scheme will probably be of interest to those who operate more or less intensive services but who have difficulty in finding room for the usual terminal loops and run-round facilities.

The scheme is particularly useful where suburban services employing tank locomotives are a feature of the traffic of the line, for the No. 2 Turntable will accommodate any of the tank locomotives of the Hornby Series, including the large No. 2 Special Tank. For tender locomotives the scheme is less suitable, but Hornby tender engines up to and including the No. 1 Special can be accommodated on the No. 2 Turntable.

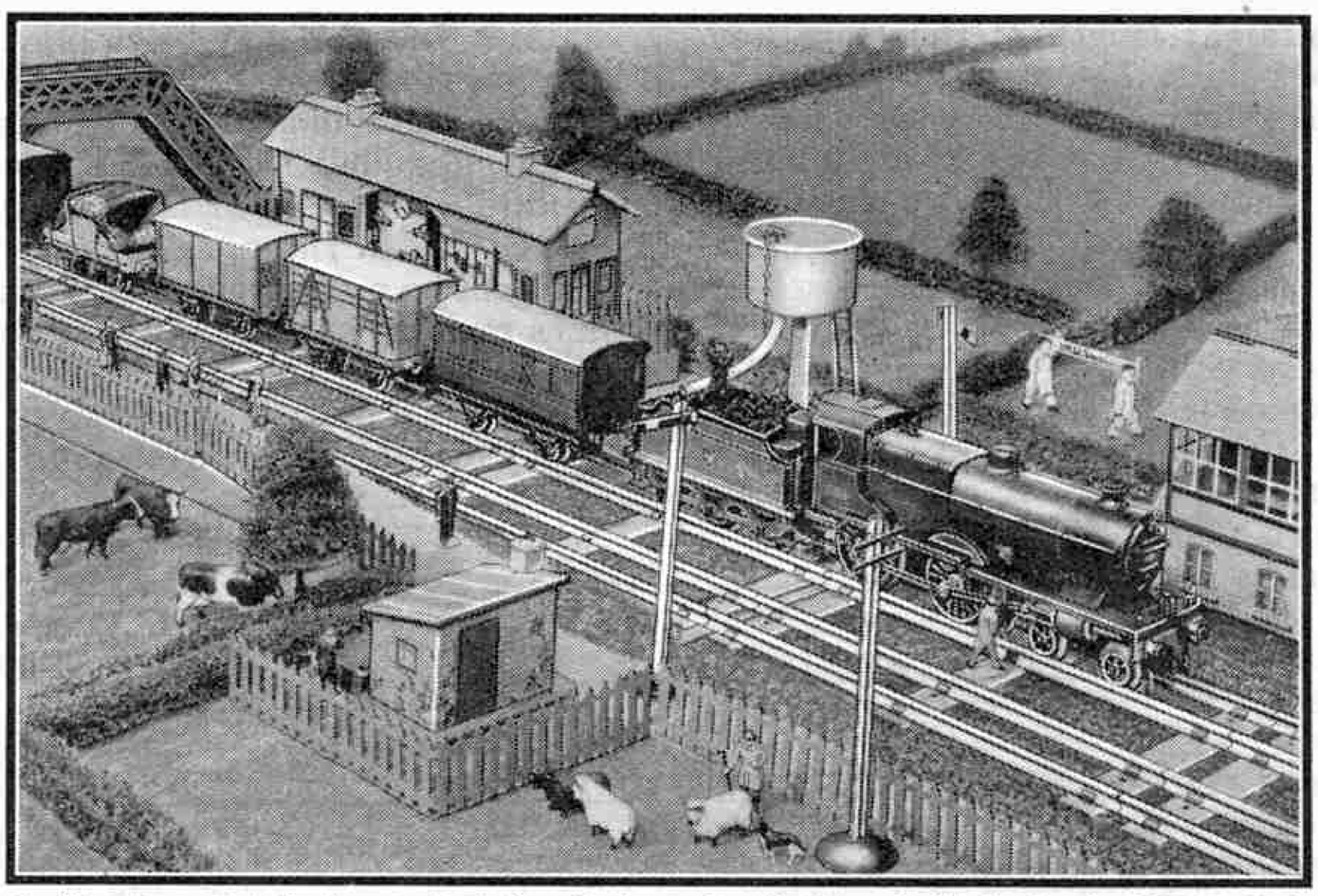


L.M.S.R. "WEST OF ENGLAND" SERVICES

THIS month we are returning to a type of article that our correspondence has shown to be extremely popular with "*M.M.*" readers generally, and members of the H.R.C. in particular. This takes the form of a consideration of the operating characteristics and other features of a section of a real railway system, with suggestions for their reproduction on a smaller scale with Hornby material. Many important systems have been dealt with from time to time in this way, and we frequently receive suggestions that other sections of our railways also should be dealt with.

A part of a system that is interesting in many respects is the section of the L.M.S.R. between Derby, Birmingham and Bristol. This was the "West of England" main line of the former Midland Railway and is certainly worthy of attention on the part of those who are on the look-out for a suitable prototype on which to base the operation of their own layout. This important L.M.S.R. line runs from Bristol up to Birmingham, where connections are made with the Western Division that enable various through workings to be carried out, as we shall see. Farther northward the Trent Valley main line of the Western Division is crossed at Tamworth, where the high-level station of the former Midland Railway is immediately above that on the lower line. The line then proceeds to Burton and onward to Derby, where the main portion of the Midland section is met. For the most part the gradients over this line are very moderate and it is therefore suited to model railway purposes, for most miniature railway systems are laid on the level, and scenic features usually are arranged to represent level country. There is, however, a notably steep section just to the south of Birmingham and special interest is attached to operations on it.

For the enthusiast who is keen on complicated routes and train workings, a reproduction even on a very small scale of the various L.M.S.R. lines in the neighbourhood of Birmingham will give interesting working, and the layout might even be arranged to represent the Birmingham district alone, with quite satisfactory results. Older readers no doubt will recall the sketch map that accompanied the article dealing with "*The Pines Express*" in the "*M.M.*" for June 1929. This gave some idea of the alternative routes possible in a journey across the Birmingham area, and those who are unable to consult this issue have only to look at an L.M.S.R. map to realise the position. In modelling this section of line there are splendid opportunities for incorporating alternative and "round-about" routes, and the return loops that many Hornby train owners are keen to include in their layouts.

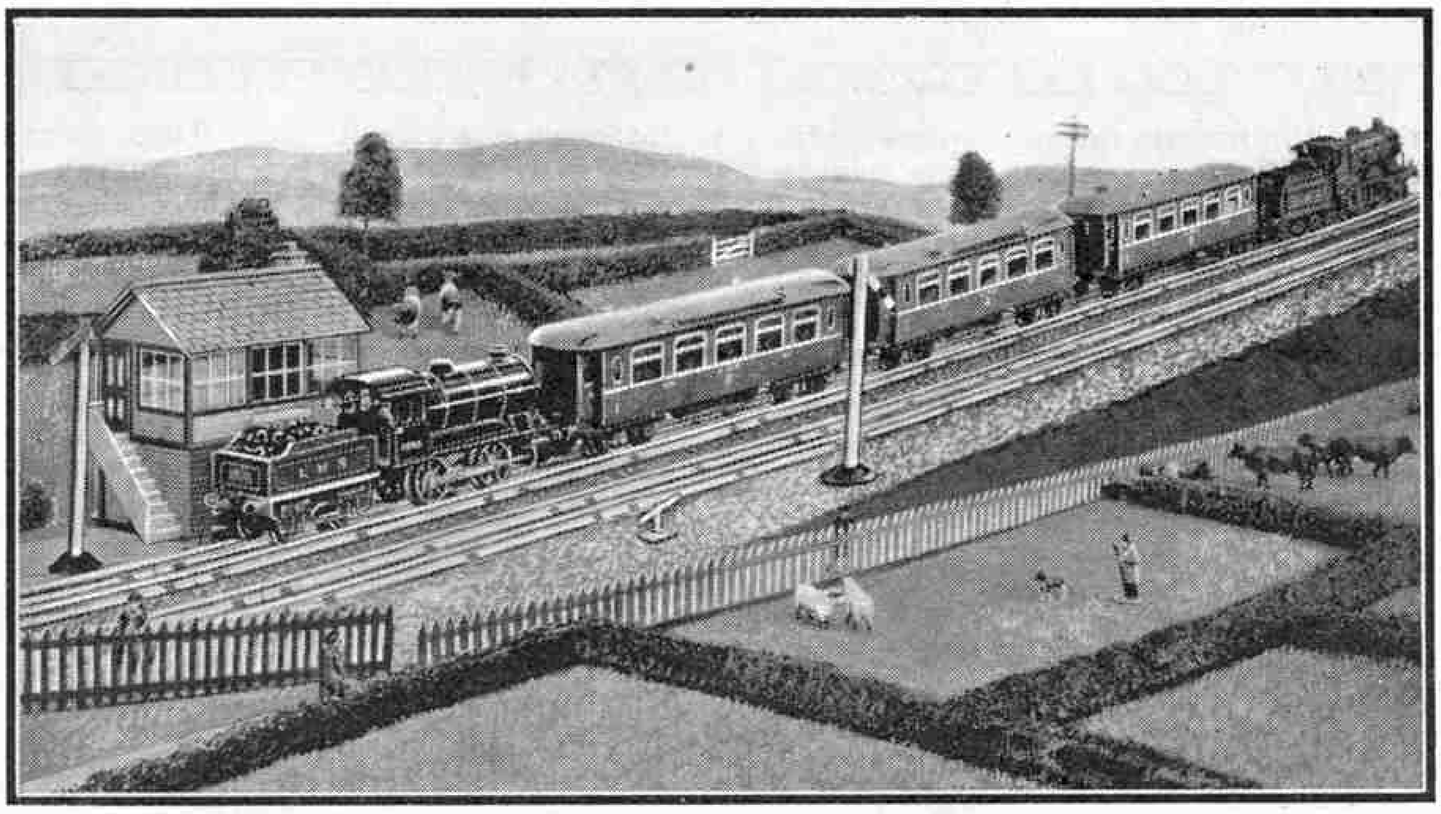


A milk and parcels train at a wayside station. The locomotive "taking water" is the Hornby L.M.S.R. No. 2 Special, which closely follows the design of the real L.M.S.R. Standard Compounds.

A further point of interest is the fact that New Street Station, Birmingham, is used jointly by the trains of the Western and Midland Divisions of the L.M.S.R., and a good example of co-operation between these two Divisions is found in the running of "*The Pines Express.*" This train gives a through service from Liverpool and Manchester. via Birmingham and Bath, to Bournemouth, and except at week ends during the summer, passes through New Street, where the transfer from the Western to the Midland Division, and vice versa, is made. It is curious to note that whether northbound or southbound the train runs in the same direction through New Street Station! This train also conveys a through Great Western coach from Liverpool to Southampton. In miniature, as in actual practice, the inclusion of a G.W.R. vehicle in the L.M.S.R. train will add to the interest of its formation as a whole.

Mention of the G.W.R. reminds us of the services jointly operated by that company and the L.M.S.R. between Leeds and Bradford and various resorts in Devonshire. The train concerned in each direction is

known as *"The Devonian,"* and forms another possible subject for reproduction on a Hornby layout. The L.M.S.R. Birmingham and Bristol main line is in fact closely associated with the G.W.R. in several respects. Apart from through workings, and the fact that Temple Meads station at Bristol is shared by the two companies, the trains of each run over jointly-owned tracks between Cheltenham and Gloucester. Again, for the distance of 20 miles or so between Standish Junction and Yate, the G.W.R. has running powers over the L.M.S.R. lines, an arrangement that appears all the more strange when it is realised that the services thus operated were once fiercely competitive and are still so to some extent. Working of this kind always appeals to the miniature railway enthusiast and interesting scenes such as that shown in the lower photograph on this page may therefore be regularly observed on a miniature railway system based on the line we are considering.



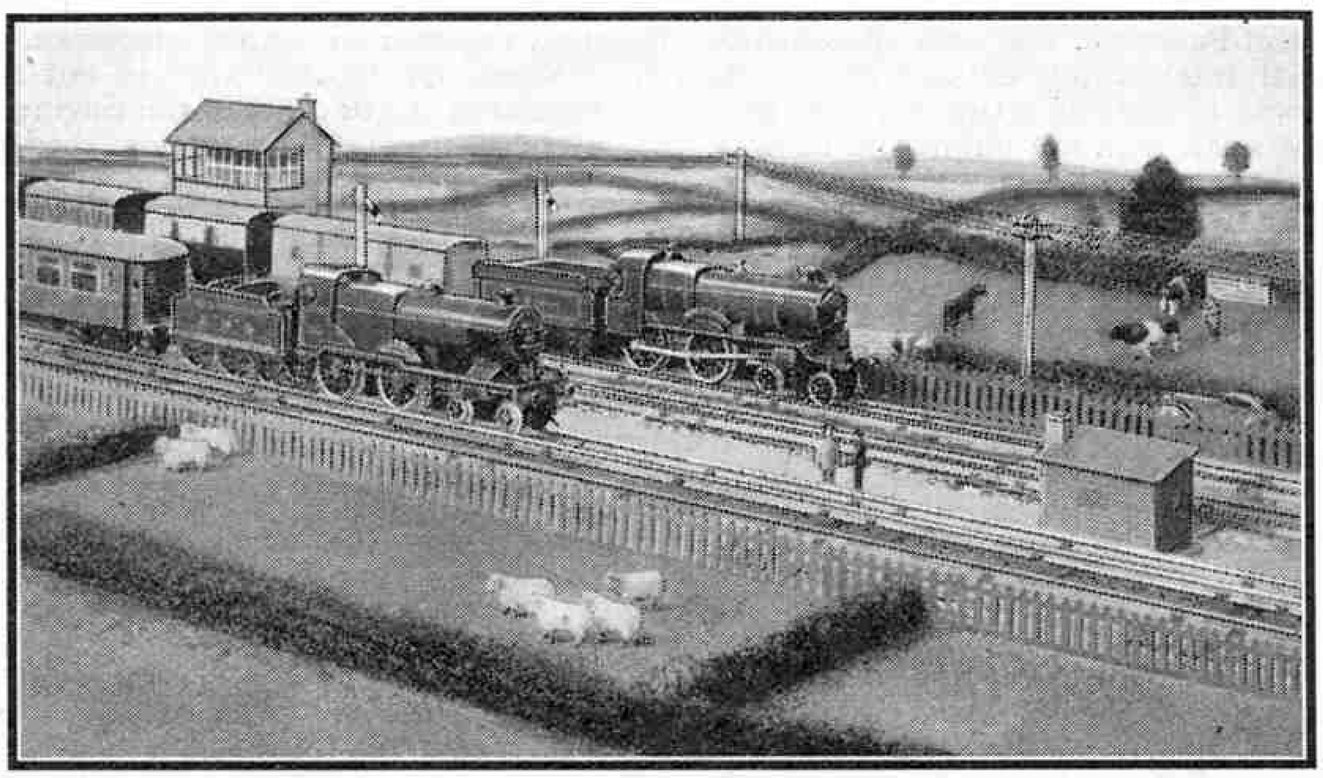
The banking engine assists a miniature L.M.S.R. express over a steeply graded section of the system. This reproduces the method of working the Lickey Incline, mentioned in this article.

If preferred, the layout as a whole might be made to represent any of the sections where G.W.R. interests also are found, rather than the complications of the Birmingham district. Thus the joint track between Cheltenham and Gloucester, or the section between Standish Junction and Yate, where running powers are involved, might be chosen as the prototype. The Bristol district itself also might be adopted, for it gives as much scope for a complicated layout as the Birmingham district, and has the added interest of inter-group working and exchange of traffic that occurs at Temple Meads.

At times of traffic pressure engine changes on through services, that would ordinarily take place at Bristol, are made at Gloucester, and L.M.S.R. trains such as *"The Devonian"* in charge of G.W.R. engines are taken over that company's line from Yate into Bristol and so on to the West. This is a specially interesting instance of working that can be practiced on a Hornby layout as a regular thing, and will serve as a good excuse for the mixing of locomotives and stock that often occurs on a model railway when two or more operators or "shareholders" are using their equipment together.

If a purely L.M.S.R. line is preferred and it is decided to restrict the line to the Birmingham and Cheltenham section, it will perhaps be desired to include a representation of the Lickey Incline, which for two miles has a gradient of 1 in 37¾. If a slope can be conveniently arranged the actual working can be closely followed. Ascending trains halt at Bromsgrove, the foot of the bank, and the assistant engine comes up in the rear. Although there is no such spectacular locomotive in the Hornby Series as the ten-coupled L.M.S.R. "Lickey Banker," that was especially built for assisting duties, the work may be undertaken by whatever suitable engine, either tender or tank, can be allocated to these duties.

With regard to descending trains, it is the custom in actual practice for passenger trains to stop at Blackwell at the top of the incline for a brake test, while freight trains halt at the same place in order to secure the hand brakes of sufficient vehicles to ensure a safe descent. Although these stops can be made in miniature they will not serve any purpose except in imagination. If the gradient is steep it may be advisable for the restraining hand of the operator to guide long trains down in safety. Much of course depends on the actual conditions obtaining on the particular layout, and it may be left to the judgment and experience of the individual operator to decide what is the best course to adopt.



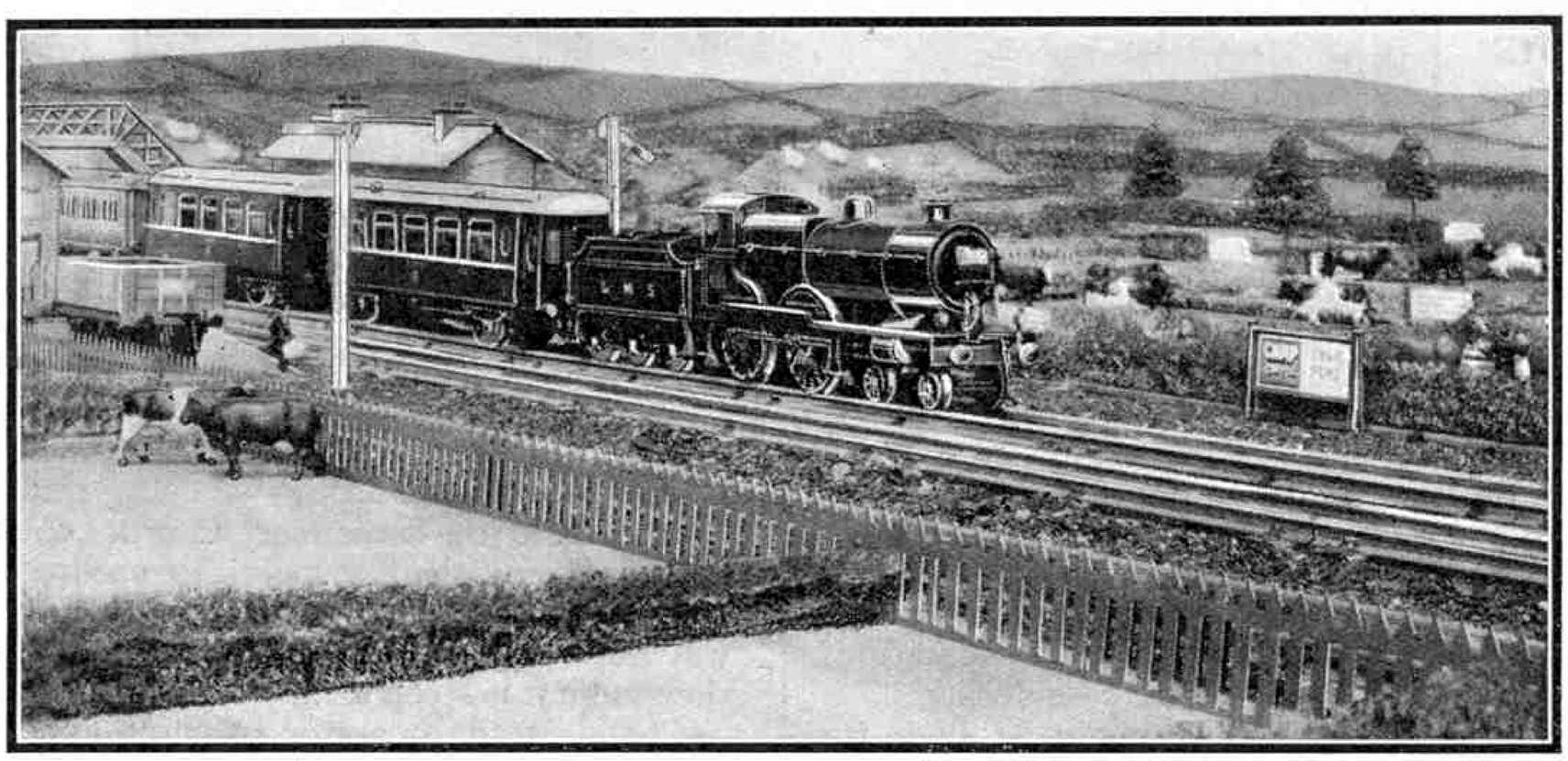
L.M.S.R. and G.W.R. trains on adjacent tracks. Such scenes as this suggest the joint working arrangements that are so popular with many Hornby railway owners.

For a layout representing a section of the former Midland line such as this, the Hornby No. 2 Special Locomotive is essentially the engine for express passenger services, for engines of the famous "Standard Compound" class undertake the bulk of the express duties between Birmingham and Bristol. Other engines of L.M.S.R. types in the Hornby Series may be employed with advantage to represent the different standard classes that are found almost everywhere on the system, and G.W.R. type locomotives of the Hornby Series can be used to represent that company over the whole of the layout, or on portions of it, according to the particular operating scheme adopted. It is interesting to note that for many years the G.W.R. "County" class engines were the largest passenger locomotives of that company allowed to run over the Midland lines between Standish and Yate. The use of the G.W.R. No. 2 Special Locomotive *"County of Bedford"* is therefore particularly appropriate in miniature working, although in practice larger engines are now permitted.

Hornby Accessories and Realism

Improving the Appearance of a Layout

IT is probably true to say that all miniature railway owners desire their layouts to be as realistic in effect as possible. Some achieve a considerable degree of success in this direction, but others fall far short of it. In making comparisons between the two classes, it is invariably found that even a small layout of suitable track design and with carefully chosen accessories will be far superior, in its realistic effect, to a more expensive and complicated layout where the accessories are badly arranged or are missing altogether. A layout of rails alone looks extremely bare and devoid of "life," although it may be of the greatest interest from the operating point of view.



A Hornby L.M.S.R. express in attractive surroundings. The Countryside Sections and other accessories such as the Station and Signals contribute a great deal to the realism of this photograph.

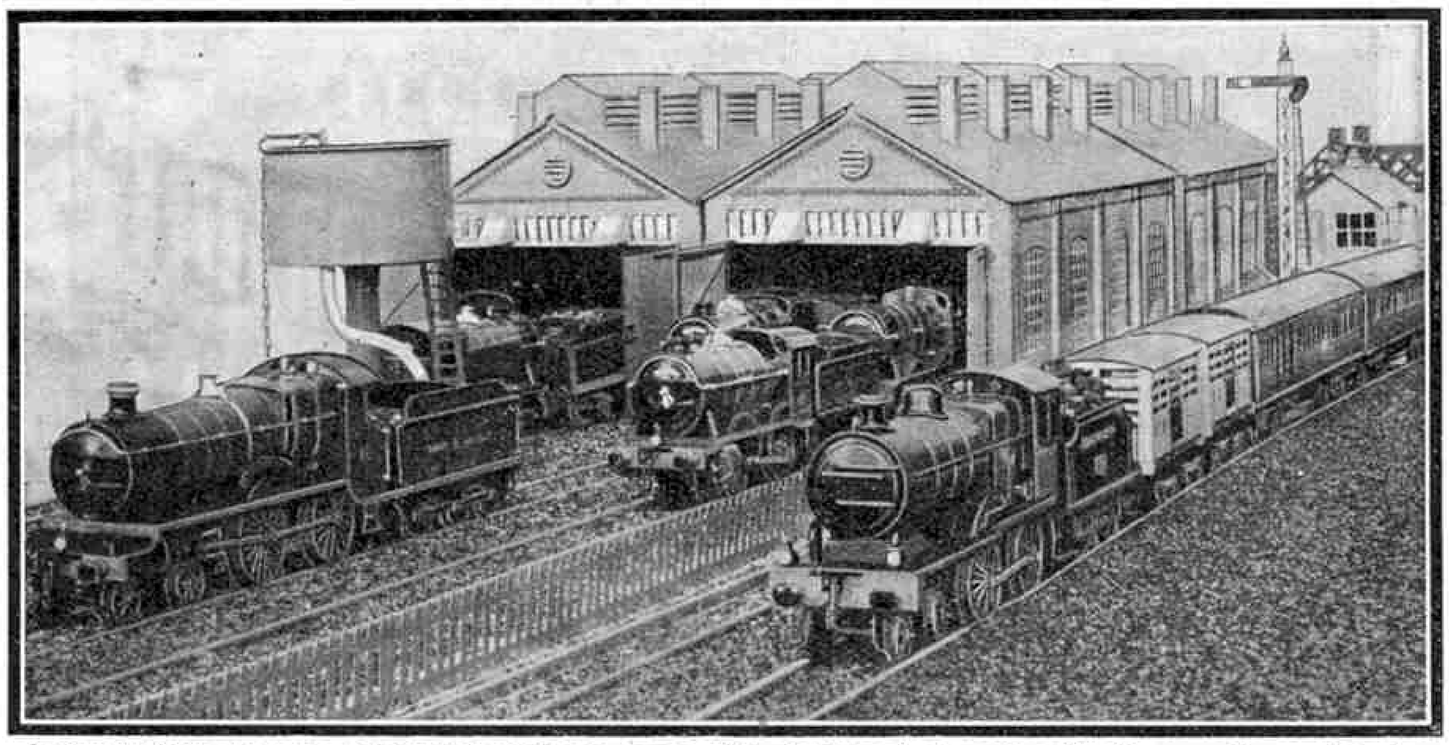
A train service cannot be run with any pretence of realism if there is no station on the railway for the trains to start from, and to stop at. The Railway Stations in the Hornby Series are of attractive design, and the No. 2 Station has the important advantage that it can be extended in either direction by the use of additional lengths of Passenger Platform, attached to the main section by a special interlocking device. The goods department must not be overlooked. The No. 2 Goods Platform is fitted with a crane and is indispensable in any miniature railway yard where there is much shunting and exchange of traffic. The No. 1 Goods Platform is less elaborate and is not fitted with a crane, but it is quite suitable for yards where separate cranes are employed, or in situations where the traffic generally dealt with does not require to be lifted.

The safety of trains in actual practice is largely due to the reliability of the British signalling system, so that if a Hornby railway is required to have a good record of safety, it is necessary to provide the signals required to govern the movements of the various trains. If placed in the correct position on a layout these contribute a great deal to the general realism of the line. In order to accommodate the signalmen, proper signal cabins must be provided. The Hornby No. 2 Signal Cabin is noteworthy because provision is made inside it for the accommodation of a lever frame. By means of this, signals and points fitted for the Hornby Control System can be operated exactly as in real practice.

Telegraph and telephone systems are largely used in connection with signalling, and this fact, apart from the public services, suggests the placing of miniature telegraph poles at suitable intervals along the lineside. These poles look extremely well if their insulators are connected by dummy "wires" of suitable thread. Among other useful lineside accessories may be mentioned the Paled Fencing for enclosing the railway property, and the Platelayer's Hut for the accommodation of the men working on the line. Then there is the familiar Watchman's Hut complete with its brazier, a very necessary detail during fog and bad weather periods in the winter months.

Of the accessories directly connected with the track, the Level Crossings take an important place, and with their white-painted gates they look most effective for double-track or single-track railways. They are made to correspond in length with Hornby rails, so that their addition to a layout does not cause any trouble or irregularity in the formation. The Viaduct is another useful accessory, and striking effects are obtainable by its use, particularly when several sections can be used together to form a succession of viaduct spans.

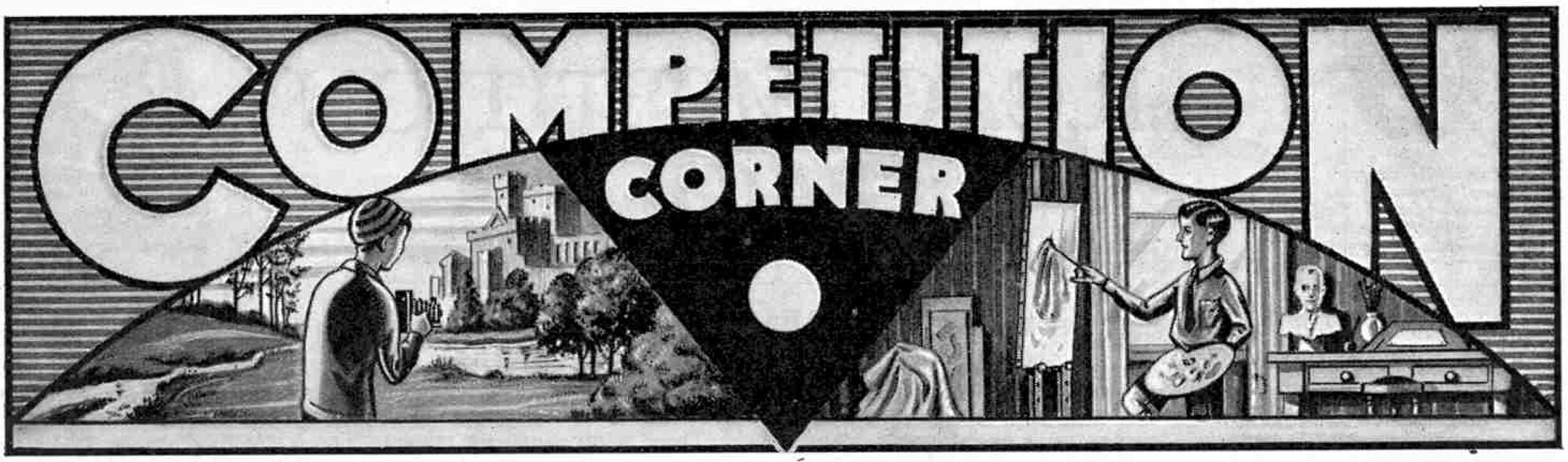
When the locomotives are not actually in use, they may be housed in one or other of the Engine Sheds. These represent accurately the usual style of straight shed with double doors. Near to the Shed will be situated the Turntable, which is a useful accessory not only for turning the locomotives round, but also for transferring them from one track to another, where the layout is arranged to permit this to be done. Close at hand should be a Water Tank, without which no miniature locomotive depot would look complete. These Tanks may also be placed in goods yards for the use of shunting locomotives, and at stations where locomotives may take water while their trains are being dealt with.



An interesting scene at a miniature locomotive depot. This photograph shows the effective use of several Engine Sheds together with a Water Tank, Paled Fencing and other details.

Railway premises generally, such as goods yards, will require Lamp Standards, and although these may be dummy fittings used only for effect, it is preferable to employ those fitted for electric lighting. Loading Gauges are another feature essential in a goods yard.

Footbridges are effective, and may be used at or near stations according to local conditions, or to break the monotony of long straight stretches of track, due regard being paid to the actual purpose of a footbridge. Small accessories such as gradient boards and mileposts practically conclude the range of accessories of an actual railway character.



A NEW DOUBLETS CONTEST

It is nearly two years since last we gave our readers a series of doublet puzzles to solve, and therefore it will be necessary to explain anew the requirements of this form of word competition.

Many years ago the doublet puzzle was almost as popular as the crossword puzzle is to-day. It was invented by Lewis Carroll, the author of "*Alice in Wonderland*," to amuse his large circle of friends. They received it with great enthusiasm, and he was persuaded to introduce it to the public, with whom it caught on immediately and became quite a craze.

A doublet consists of two given words, each containing the same number of letters. The puzzle requires one word to be changed to the other by placing connecting words between. The connecting words are known as "links," and must differ from the preceding link by the alteration of one letter only. Only words of the same length may be used, obviously, and the test is to make the change in the smallest number of links.

To make the idea clear we give the following examples:

Put LOAD in CART
LOAD–lord–cord–card–CART
Protect CAT from DOG
CAT–cot–dot–DOG

In making the links only English words appearing in a standard dictionary may be used. Proper nouns, names of persons, places, etc., are not permitted. It is important to remember that the first solution arrived at is not necessarily the shortest. Competitors should go over their solutions carefully in search of short cuts that will eliminate unnecessary links. Close study will often reveal overlapping links that may be removed.

The Doublets to be solved are as follows:

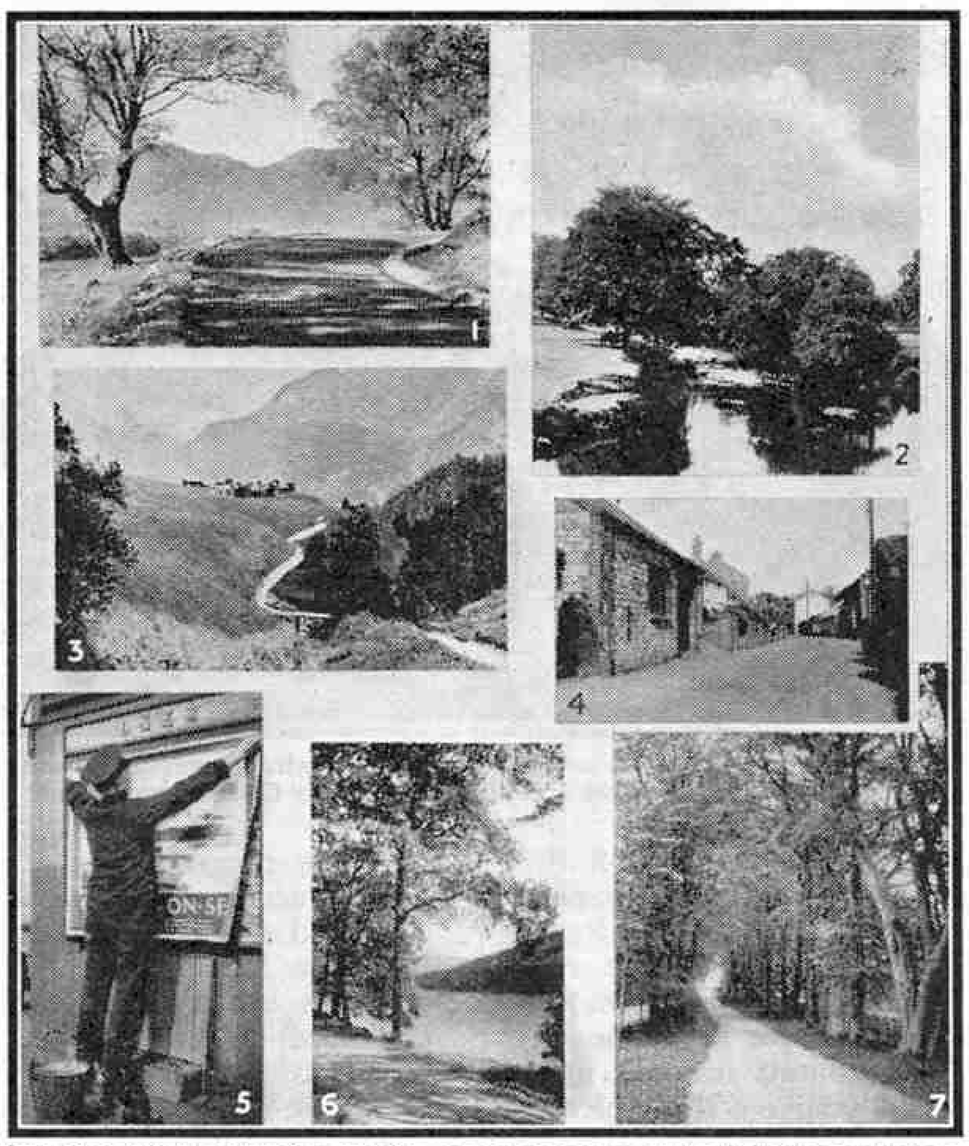
Put	CASH	in	BANK
Steer	SHIP	from	DOCK
Uproot	TREE	from	WOOD
Make a	RING	of	WIRE
Make	PARTS	into	MODEL
Count	DAYS	in	WEEK
Increase	WIND	into	GALE
Thread	KEYS	on	RING
Turn	WORK	into	PLAY
Buy	FISH	from	SHOP

In judging the entries, the 10 doublets will be considered as one contest, and prizes of Meccano or Hornby Train goods to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the senders of the four solutions showing the lowest total of links used throughout. In the event of a tie for any of the prizes, preference will be given to the entry having the neatest or most novel arrangement.

It will be observed that the combination of the 10 doublets for judging purposes will ensure that a brilliant solution of one doublet will carry its full weight by offsetting to some extent failure to secure the shortest chain in another.

Entries should be addressed to "Doublets, Meccano Magazine, Binns Road, Liverpool 13," and sent to reach this office not later than 28th February. There will be a duplicate set of prizes reserved for entries from Overseas readers, whose entries must reach us not later than 31st May.

Entries must be written on one side of the paper only, and each sheet of paper used must bear the competitor's name and address. The total number of links used must be noted on the first sheet.



We give above a selection of prize-winning entries to the 1934 Photographic Contests. The pictures are as follows: 1. "The Bend in the Road"—A. P. Gardner; A Section 1st Prize, September; 2. "The Cloud Surveys"—J. L. Rice, A1, June; 3. "An Alpine Hamlet"—F. H. Culverhouse, A1, July; 4. "Lympstone Forge, Devon"—F. H. Smyth, B2, July; 5. "Bill Posting"—A. F. Pegler, B1, June; 6. "By the Side of Loch Noil"—W. J. Aitken, A2, July; 7. "Autumn Lane"—D. H. Warner, B1, September.

February Drawing Contest

For our drawing competitions this winter we have decided to give our readers a free choice in the matter of subjects, and accordingly prizes are being offered each month for the best drawings or paintings submitted, irrespective of subject, size of the entry, or method of production.

Each month's entries are divided into two sections, A for those aged 16 and over, B for those under 16, and prizes of Meccano products to the value of 21/– and 10/6 respectively, are awarded in each section.

Entries to the February Contest must be addressed "February Drawing Contest, Meccano Magazine, Binns Road, Liverpool 13," and must arrive not later than 28th February. Overseas closing date, 31st May.

Competition Closing Dates

HOME

Doublets	28th February
February Drawing Contest ...	28th February

OVERSEAS

November Crossword Puzzle ...	28th February
November Drawing Contest ...	28th February
Advertisement Jig-Saw Contest...	31st March
Feature Voting Contest	31st March
December Drawing Contest ...	31st March
Cover Voting Contest	30th April
January Drawing Contest ...	30th April
Doublets	31st May
February Drawing Contest ...	31st May

Watch the Closing Dates:

Competitors, both Home and Overseas, are particularly requested to make a careful note of the closing dates of the competitions.

COMPETITION RESULTS

HOME

December Drawing Contest.—First Prizes: Section A, T. R. Simm (London, S.E.7); Section B, J. Boldry (Doncaster). Second Prizes: Section A, A. W. Barr (Gillingham); Section B, S. Geary (Burton-on-Trent). Special Prizes: Section A, James Ashton (Salford, 6); A. E. Lukey (London, N.W.1). Consolation Prizes: E. Buckman (Redhill); J. Saunders (London, S.E.6).

Holiday Story Contest.—1. M. Tucker (Reigate); 2. B. J. Powell (Misterton); 3. P. Griffiths (Burny Port); 4. H. Everitt (London, S.W.16).

December Feature Voting Contest.—1. D. G. Lyon (Plymouth); 2. E. R. Bullen (Southampton); 3. K. E. Milburn (London, E.4); 4. C. C. Fowler (Ochiltree).

OVERSEAS

September Photo Contest.—First Prizes: Section A, R. de Souza (Singapore); Section B, F. G. Roberts (Montreal); Second Prizes: Section A, J. Credie (Capetown); Section B, T. B. Jones (Sydney).

Advertising Slogans.—1. J. L. Morley (Sydney, N.S.W.); 2. S. B. Davis (Auckland, N.Z.); 3. I. G. Kay (Toronto); 4. S. Johnson (Otago, N.Z.).

H.R.C. COMPETITION PAGE

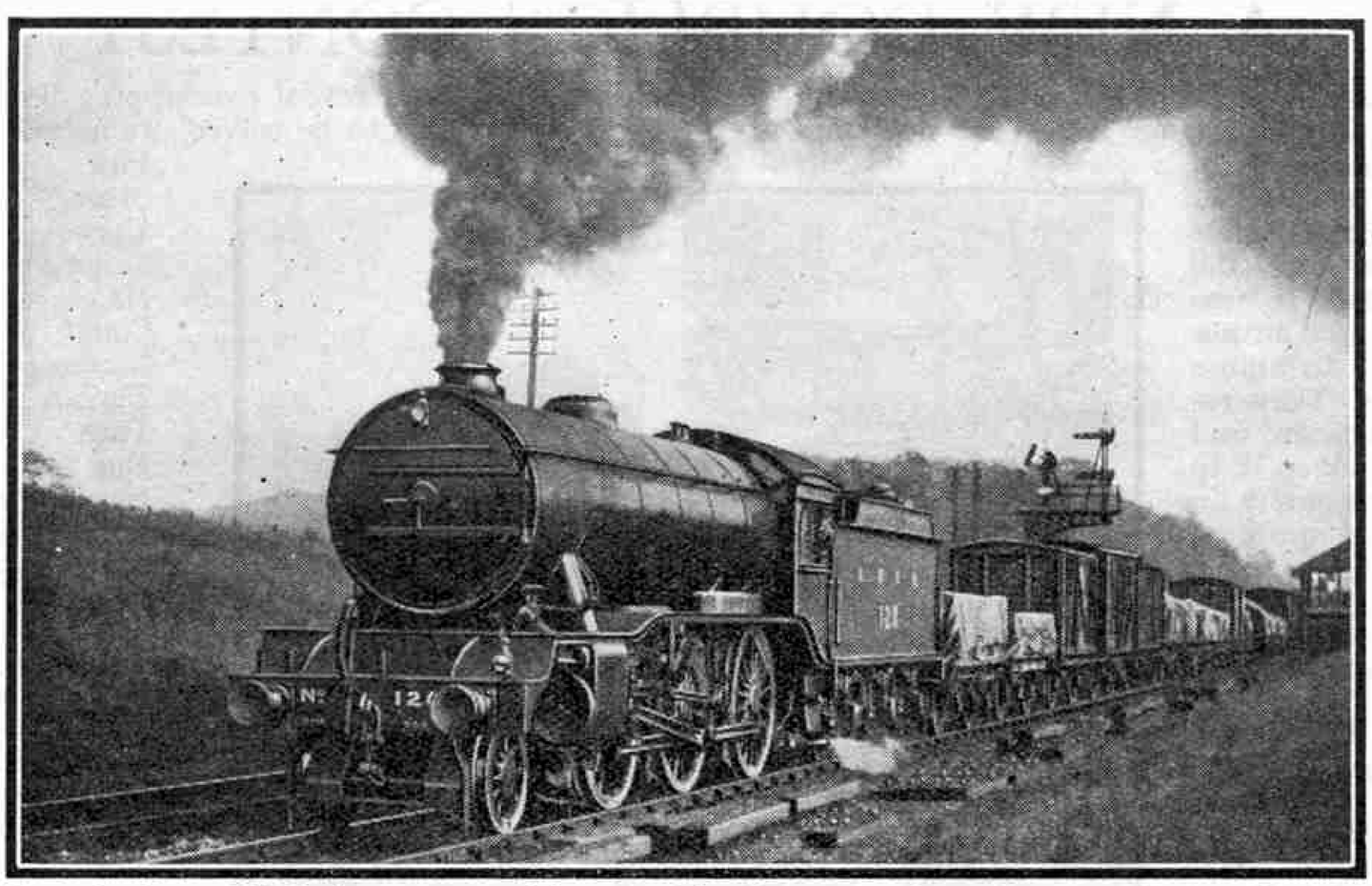
Join the Hornby Railway Company and become eligible for the competitions announced on this page.

Join the Hornby Railway Company and become eligible for the competitions announced on this page.

A "NIGHTMARE GOODS" DREAM

To travel on the footplate of a locomotive is the greatest desire of every railway enthusiast, but this privilege is seldom granted. Not long ago an H.R.C. member was fortunate enough to obtain permission to make a footplate journey on a night goods train. His excitement during the time until the day fixed for the trip got more and more intense until one night, after a particularly heavy supper, he dreamt of his prospective journey. Unfortunately in his dream matters got very mixed up and he travelled on an impossible train. A few days later we received from our member a description of his dream. We decided that it would make an excellent subject for a competition of the kind in which entrants are required to pick out as many mistakes as they can from a description of a journey.

Therefore we give below the account as we received it and H.R.C. members will agree that they have plenty of opportunity for finding mistakes! Competitors should make a list of as many errors as they can find, in the order in which they occur, on one side of a sheet of paper and on the other side should be written the name, full address and H.R.C. number of each competitor. Here then is the story:



The coal train on which the journey was made is seen entering the concentration yards at Dover Marine. The 4-4-2 locomotive mentioned in the account is of typically G.W.R. appearance.

"My journey commenced on a night freight from Cheltenham. We had a heavy load of 40 vehicles including meat for Birkenhead, steel from Sheffield and other places. The locomotive concerned was one of the G.W.R. "Atlantics" built last year by the Vulcan Foundry Ltd. at their famous works at Gorton. The first part of the journey was more or less uneventful, the locomotive travelling with ease through the Severn Tunnel. The first trouble was a check experienced at Taunton where the new upper-quadrant colour-light signals obstinately refused to fall to the "all-clear" aspect. Eventually we passed Stafford and our engine picked up water from the troughs. We were now on the climb to Stoke summit, the highest point reached by a main line railway in this country and stopped at Blackwall for the usual banking assistance up the 1 in 36 gradient. Our booster-fitted engine, aided by the banker soon reached the summit.

Three miles north we passed *"The Night Scot"* made up of the distinctive green and cream "Tourist" coaches used on this service. I just had time to notice it was hauled by two of the famous Stirling "8-footers" as it flashed by us. Dawn was just breaking as we passed through the busy yards at Bakewell and stopped by the Junction for train examination and a change of engines. What a thrill I got when *"Earl Marischal,"* the latest Doncaster 4-cylinder compound, came on! With its special crank setting the eight exhaust beats to each turn of the wheels sounded very strange as we headed out of the yards, and passed through the busy manufacturing area beyond the town. Totley tunnel loomed ahead but we were soon through its cavernous depths and passing Newbury. After Banbury we negotiated the various junctions at Beckenham and so gained access to the Brighton main line. Part of our load was detached at Three Bridges and we then soon completed our journey to Dover Marine."

Prizes of Hornby Railway material (or Meccano products, if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively, will be awarded to the four competitors in each section, Home and Overseas, whose entries list the largest number of mistakes in the story just told.

Every entry submitted for this contest must be clearly marked with the sender's name and full address and H.R.C. membership number. Envelopes containing entries must be clearly marked *"H.R.C. February Nightmare Goods Contest"* in the top left-hand corner and posted to reach Headquarters at Meccano Limited, Binns Road, Liverpool 13, on or before 28th February. The closing date for the Overseas section is 31st May.

Word-Building Contest

This simple competition is one which all H.R.C. members will wish to enter. All that competitors are required to do is to make as many different words as they can out of the letters forming the words *"HORNBY TRAINS."* Only English Dictionary words may be used.

Entries should be written on one side of the paper only, and the total number of words found should be stated.

The contest will be divided as usual into two sections, Home and Overseas, and prizes of Hornby Train or Meccano products to the value of 21/–, 15/–, 10/6 and 5/– respectively, will be awarded to the four winners in each section.

Envelopes containing entries must be marked *"H.R.C. February Word-Building Contest"* in the top left-hand corner, and posted to reach Meccano Ltd., Binns Road, Liverpool 13, on or before 28th February. Overseas closing date 31st May.

Railway Photographic Contest

Prizes of Hornby Train material (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– will be awarded this month in each section, Home and Overseas, of the usual Photographic Contest for photographs of *Any Railway Subject.*

Envelopes containing entries should be marked *"H.R.C. February Photographic Contest"* and posted to reach Headquarters at Meccano Limited, Binns Road, Liverpool 13, on or before 28th February. The Overseas closing date is 31st May.

COMPETITION RESULTS

HOME

November "Rolling Stock Contest No. 3."—1. E. Beven (35158), Birley Carr, Sheffield. 2. H. T. Buckingham (23588), Leighton Buzzard, Beds. 3. W. Hudson (1733), Westham, Weymouth, Devon. 4. R. Nuttall (14163), Burley-in-Wharfedale, Yorks.

November "Questions Contest No. 6."—1. K. Gandy (7571), Sheffield. 2. W. W. Boyles (17260), Beeston Common, Sheringham. 3. H. S. Wright (6281), Grange-over-Sands. 4. L. Reason (32408), Bushey, Herts.

OVERSEAS

August "Locomotive Mixture Contest."—1. G. Hallack (17578), Capetown, S. Africa. 2. R. A. Wragg (7913), Bandikui, Rajputana, India. 3. D. Parker (38595), Brussels, Ontario, Canada. 4. V. L. Shillcock (21200), Arncliffe, N.S.W., Australia.

August "Drawing Contest."—S. D. Kurlawala (28724), Tardeo, Bombay, India. 2. E. C. Heath (29104), West Pennant Hills, N.S.W., Australia.

August "Photographic Contest."—1. A. A. Boult (50), Auckland, New Zealand. 2. F. L. Bingen (28995), Wyk-Maastricht, Holland.

EVERYTHING PROVIDED FOR

The workmen engaged in building a new garage were about to leave for the day.

"Won't you clear up this wood and other material?" asked the owner of the house. "Some of it will be lost."

"That's all right, sir," replied one of the workmen, "you'll find it all in the bill."

* * * *

Hotel Manager (bragging about his band): "A wealthy patron offered £100 for the violin on which this solo is being played."

Guest: "I can't afford anything like that, but I'll willingly give the player £2 to stop."

* * * *

"What is your greatest difficulty in life?"

"Trying to sleep while my alarm clock rings."

* * * *

She: "What's that curious thing?"

He: "A sundial. It tells the time by the Sun."

She: "How amazing these modern inventions are!"

* * * *

"We put out that fire last night within ten minutes of arriving," said the fireman.

"Had it got a good start?"

"I should say so. Why, when we arrived there was nothing left but the basement."

* * * *

"How did Brown manage to win the cross-country race?"

"He was dead beat and sat down for a rest."

"How did that help him?"

"He sat on a wasps' nest."

* * * *

"How is it you are home so early from the theatre?"

"I came out after the first act."

"Why did you do that? Didn't you like the play?"

"Yes, it was a good show, but I couldn't wait. The programme said there was an interval of two years between the first and second acts."

* * * *

"My teacher's awfully mean."

"Hush, you mustn't say that!"

"Well, she is! She asked for my knife to sharpen my pencil to give me a bad mark!"

* * * *

"So your son is still at the University?" inquired the visitor. "And what is he going to be when he takes his degree?"

"A very old man!" replied the father, with deep feeling.

* * * *

TOO TRUE

Stranger: "Say, bo, does Si Jones live around hyer?"

Quick-Draw Steve: "Nope."

Stranger: "But they told me he lived only a gunshot from you."

Quick-Draw Steve: "He did."

UNANIMOUS

"Now children, stop quarrelling. Can't you ever agree?"

"We have agreed this time, mother. Bill wants the biggest piece of cake and so do I."

* * * *

"I'm going to give you a piece of my mind."

"Just a small helping, please."

* * * *

Judge: "You still say you're innocent, though six witnesses saw you steal the hen?"

Prisoner: "Your Honour, I could produce six thousand people who didn't see me."

* * * *

A TALL ORDER

Workman (on top of scaffolding for new building): "Hi, Bill, chuck up that 'ammer!"

* * * *

Tenant: "The people in the flat above me won't give me a minute's peace. This morning at one o'clock they were jumping up and down on the floor as hard as they could."

Landlord: "They woke you up I presume?"

Tenant: "No. I hadn't gone to bed."

Landlord: "Ah! You were working late?"

Tenant: "Yes. I was practising on my saxophone!"

* * * *

"What you want, Mr. Skinflint," said the doctor, "is a new lease of life."

"Yes," replied the miser. "That is, of course, if the rent is not raised."

* * * *

"There's no doubt about it, young Roadhog is a live wire."

"That accounts for his shocking habits."

* * * *

Wullie (on a visit to London with his father): "Are we gaun tae a theatre the day?"

Sandy: "Nae, nae, laddie. We haven'a seen a' thae shop windows yit."

* * * *

"Bill is a brainy fellow in business."

"Why?"

"He arranges football matches for men over fifty, for charity, and the day after he goes and sells them embrocation."

* * * *

"I never worry."

"Never?"

"No; in the daytime I'm too busy, and at night I'm too sleepy."

* * * *

"Yes," said the teacher, "a number of plants and flowers have the prefix 'dog.' For instance, the dog-rose, the dog-violet. Can any of you name another?"

"Please, miss," called a boy in the back row, "collie-flowers."

OPEN WIDE!

Fortune Teller: "You have the gift of oratory. When you speak I should imagine people listen open mouthed."

Client: "That's right. I'm a dentist."

* * * *

"I should love to look at it for ever," said the girl on her first visit to Niagara. "Wouldn't you?"

"Rather not," replied her brother. "I should just hate to have a cataract always in my eye."

* * * *

Rastus: "Did you eber see a hen's egg as little as dat?"

Sambo: "Much smaller! Why, Ah've seen 'em as little as two of dose."

* * * *

"I hear you are running a duck farm," said Bill. "Business picking up?"

"No," replied Dick, "picking down."

* * * *

"Do I really need all this attention?" asked the visitor of a negro attendant who was brushing his coat.

"Yas, sah, you most decidedly do, sah," replied the Negro. "You see, I'se broke."

* * * *

Father: "Always remember, my boy, to think before you speak."

Son: "But when I do that, Father, the others have changed the subject."

* * * *

Smith was asked by his teacher to make a sentence containing the word archaic.

"We can't have archaic and eat it too," replied Smith.

* * * *

Chairman of meeting: "It is safe to assume that a new cycle of business is upon us."

Hard-hit shopkeeper: "Then let us hope that it is a buycycle."

* * * *

The midshipman's knowledge was being put to the test.

"Suppose a sudden storm sprang up on your port side, what would you do?"

"Cast the anchor, sir," replied the boy.

"And if another came aft?"

"Cast another anchor, sir."

"If yet another storm sprang up on the starboard?"

"Cast another anchor," was the reply.

"And where are all these anchors to come from?" demanded the examiner.

"The same place you are getting your storms from, sir."

* * * *

PRESENCE OF MIND

Panting and perspiring, the tandem riders reached the top of the hill. "Ba gum, Joe," gasped Ned, "that wor a stiff 'ill."

"Aye, it wor an all," puffed Joe. "If I hadn't kept t'brake on, we'd a gone back'ards."

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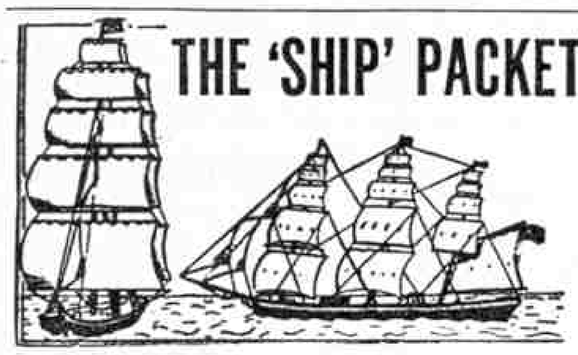
CONRAD A. REISS (DEPT. M), 1, CASTLE GARTH, KENDAL.



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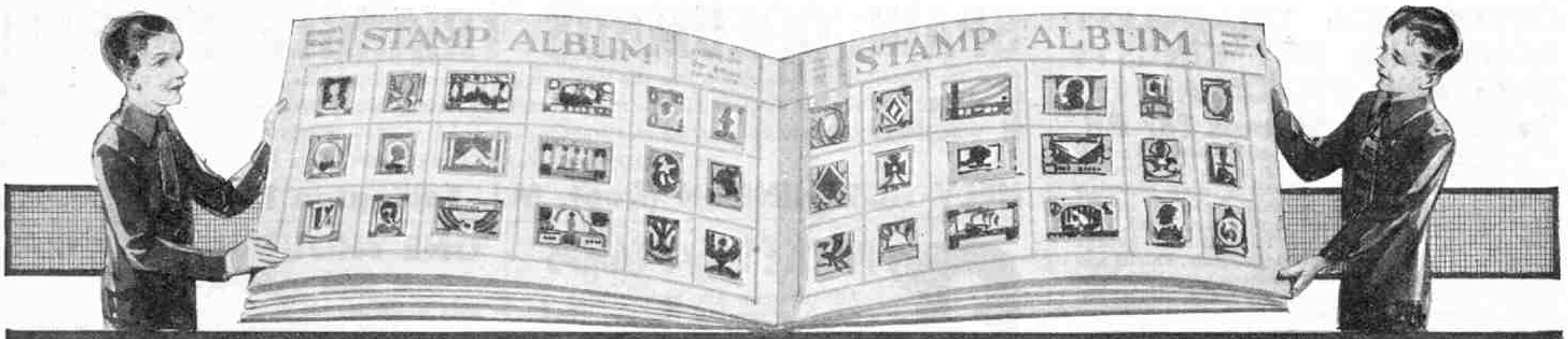

STAMP COLLECTING

CATALOGUE TERMS EXPLAINED

LAST month we discussed the problems confronting the collector in re-arranging his collection in a new album, and suggested several general points that should be observed in such a process. The most important of those points was—give the stamps plenty of room. It is not less important to obtain a catalogue to use as a plan in arranging the new layout of the stamps and compiling the brief descriptive matter that is to accompany the stamps.

Obviously, before any plan can be used with complete success, it is essential that the terms it uses must be understood. In this article, therefore, we propose to explain briefly some of the more puzzling of the terms in common use in stamp catalogues. Considerations of space compel us to omit many elementary terms such as perforations, roulettes, watermarks, shades, etc., but these have been explained in recent issues of the "*M.M.*," and we may safely assume that they are well understood.

Before any stamps are mounted in the new album, the collector must decide what is to be included, and no doubt an early point will be to exclude all but adhesive stamps.

In these days of air mail services, however, some provision must be made for "entires." The keen aerophilatelist, as the air post collector is now dubbed, takes the view that "the cover's the thing," and the modern general collector would be well advised to make special provision for housing "covers" and "entires," as completed used envelopes are known. The postmark, as well as the stamp, tells a story, while in the case of air mail covers—those from first flights particularly—the story is often amplified by a "cachet," usually a pictorial device embodying brief details of the flight, impressed on the cover. The "cachet" is, indeed, a certificate that the cover has been carried upon a particular flight.

In collecting air mail covers, readers should not overlook the importance of the "backstamp" as evidence that the cover has actually been flown. Many countries permit the use of air mail stamps on ordinary mail, and the "backstamp," a postmark applied to the back of the cover by the receiving office, in conjunction with the postmark or "cancellation" of the forwarding office, provides evidence of the time taken in transit. Not all genuine air mail covers are backstamped, unfortunately.

While touching on the subject of covers and postmarks, it will be well to refer also to "meter franks," a system of prepaying postal charges that is gaining tremendous popularity with business houses throughout the world. Briefly explained, a "meter frank" is an impression, serving the purpose of a postage stamp, printed on the envelope by a machine that has previously been set by the postal authorities to print franks up to an agreed amount, paid in advance by the user of the machine. When this sum is exhausted the machine automatically locks itself. The impression embodies the registered number of the impressing machine, and in most cases it also includes a neat advertising device, featuring the name of the user and the brand name of his products, or possibly an advertising slogan.

This form of postmark advertising must not be confused with the "slogan postmark" that is commonly added to the ordinary dated cancellation to-day to focus attention on some matter of national importance. Thus in Britain we get postmarked exhortations to "Post Early for Christmas," or "Save Time by Telephone." A collection of such slogans, in common with the other "cover" features we have mentioned, is so full of interest as to justify reservation to a special album.

There are several forms of adhesive pre-paid stamps, notably the U.S.A. "pre-cancels," that should go into the main album. With a view to reducing the work of postmarking envelopes after posting, U.S.A. post offices supply business houses with coils of stamps already impressed with cancellation bars and the name of the issuing office. Recently a young reader sent such a stamp to us and asked if it were a "re-print." His reasoning was quite easy to follow and by no means illogical, but the two things are poles apart. "Re-prints" are reproductions of stamps produced from the original plates at some period after the issue of the original stamps has ceased. At one time the issue of "re-prints" for the use of stamp collectors was quite a common practice, and many such issues prepared officially have a definite standing and quite considerable value. Others, of an unofficial nature, are worthless, but readers need have no fear of being caught by such rubbish if they will make a point of buying their stamps only from established stamp dealers. Most countries do not permit "re-printing" to-day.

To some degree the "re-print" might be considered a specimen stamp, but there is a definite class of stamps known as "specimens," and these bear the word overprinted across their face. They are issued for official purposes such as distribution through the Bureau of the Universal Postal Union, for inclusion in the official collections of other countries. By their nature "specimen" stamps are rare, but, except in a few isolated cases, their value is much below that of standard issues.

There is another variety of stamp known as "cancelled to order," that comes within the group of stamps cancelled before issue. Many Governments sell off their surplus stocks of stamps after an issue has been withdrawn from circulation, and when the sale is at less than face value a cancellation is applied to prevent the postal use of the stamps. Such stamps usually can be identified by their extremely clean condition and by the presence of gum on their backs.

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KINGS' HEADS, Colonial and Foreign Duplicates for disposal. One Farthing per stamp. Send postcard for trial.—Philatelist, 32, Josephine Av., Brixton, S.W.2.

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THE PUCKA STAMP CO., 27, Normandy Ave., Barnet.

Stamp Gossip

and Notes on New Issues

An Argentine Commemorative

To commemorate the Eucharist Congress held in October last at Buenos Aires, the Argentine issued two very fine new stamp designs, one of which we illustrate here. This design, used for the 10c. value, shows the famous statue known as *"Christ of the Andes,"* which stands in the Uspallata Pass on the Argentine-Chilian frontier as a symbol of peace between these two countries. It was erected to commemorate the settlement by our late King Edward VII of the long-standing boundary dispute between the two countries. The second stamp of the series, a 15c. value, shows the magnificent cathedral at Buenos Aires, where lies the body of Argentina's national hero, San Martin.

Grenada's Pictorial Issue

The change-over of the British Colonial stamp designs from the simple King's Head type to pictorial designs, is proceeding apace, and this month we are able to show a specimen from Grenada's new issue, a worthy companion set to the recent issues from St. Helena, Ascension and British Guiana. The series of 10 stamps uses only four designs, from which we illustrate the 1d. value, a composite picture showing the badge of the Colony and the King's Head.

The other three designs show respectively the Grand Anse Beach; the Grand Etang, a lake about 7 miles from St. Georges, the capital of the Island; and a view of St. Georges itself. The King's portrait in three-quarter profile appears in the top right-hand corner of each of these designs. Thus tradition is satisfied without detracting from the beauty of the designs.

* * * *

A successful rocket post experiment was carried out on 30th October in the neighbourhood of Trieste, when a distance of 4,000 metres (about 3 miles) was covered. The letters enclosed in the rocket bag were franked with two triangular and imperforate stamps, 5L and 7L.70, both showing an eagle hovering over a globe and a mail rocket in flight. The stamps were inscribed "Trieste, Ottobre 1934, esperimenti di posta per razzo expresso."

The Christmas Charity Issues

The most interesting of the Christmas, 1934, Charity issues undoubtedly is that of Germany. A very striking break from tradition has been made, and instead of featuring one of the ancient German legends or several of the country's historic showplaces, the nine stamps are devoted to distinctive types of German artisans and professional men. It is perhaps a little unfortunate that the same model was used for each of the designs, with the result that the nine men are apparently brothers!

We illustrate three of the designs, the 3 pf., showing a Clerk; the 20 pf., a Scientist; and the 40 pf., a Judge. The remaining values and designs are as follows: 4 pf., Blacksmith; 5 pf., Mason; 6 pf., Coalminer; 8 pf., Architect; 12 pf., Farm Labourer; 25 pf., Sculptor. Each of the stamps was sold at a premium for the benefit of the National Winter Relief Funds.

As a very striking contrast to the German issue, the single design used for Luxemburg's Charity issue is worth studying. As our illustration shows, the design features the coat of arms of *John the Blind,* King of Bohemia and Duke of Luxemburg. *John the Blind* was killed on the field of Cressy but, contrary to popular legend, his badge was not the three ostrich feathers and the *Ich Dien* motto that the Black Prince is supposed to have taken for his own on John's death.

There is not space here to give detailed descriptions of the remaining charity issues that appeared, but we have selected specimens from each of the Austrian, Belgian, Dutch, Swiss *Pro Juventute* and Saar Valley issues, for illustration.

With the exception of the Austrian and Swiss issues, the designs are all symbolical of the aims of the issues. Austria has chosen to feature portraits of famous Austrian architects of modern and early times, while Switzerland shows typical specimens of Swiss girlhood.

MacArthur Centenary Issue

Another interesting Australian commemorative appeared recently to mark the centenary of the death of Captain John MacArthur, whose introduction of the Merino breed of sheep into Australia was the first step in the founding of the Commonwealth's huge wool industry. The issue consists of three stamps, 2d., 3d. and 6d. values, each bearing the same design, featuring a merino ram.

Trinidad's New Stamps

Official approval has now been given to the proposed designs for the new definitive issue for Trinidad and Tobago, and it is anticipated that the stamps will be issued in the very near future. The stamps are to be denominated in decimal coinage, instead of shillings and pence as hitherto, and the values will be 1c., 2c., 6c., 12c., 24c., 48c. and 72c.

The pictorial designs will display a range of views of the islands and their principal features, as follows:

1c., the first Boca; 2c., the College of Tropical Agriculture; 3c., Mount Irvine Bay; 6c., Raleigh's discovery of the asphalt lake in 1595 (this, probably, will be the young collector's favourite design in the series); 8c., Queens Park, Sarawak; 12c., the Town Hall, San Fernando; 24c., Government House; 5/–, Memorial Park; £1, Blue Basin, a remarkably beautiful waterfall and pool.

Gibbons' Air Stamp Catalogue

(Stanley Gibbons Ltd., 391, Strand, London, W.C.2)

The most striking feature of present-day stamp collecting is the enormous popularity of air stamps. Many people who did not previously collect stamps have been attracted to the hobby by its close connection with flying. The new edition of the Stanley Gibbons' Air Stamp Catalogue provides evidence of the rapid expansion of the Air Mail, for its pages have had to be increased by over 50 per cent. to provide space for the new air stamps of the past two and a half years. The little volume now comprises 190 pages and includes over 700 full size illustrations.

The prices in the new edition in many instances show marked appreciation and many stamps within reach of the average collector have appreciated by several hundred per cent. The new catalogue can be obtained from any stamp dealer price 1/6, or direct from Stanley Gibbons Ltd., 1/9 post paid.

We thank Stanley Gibbons Ltd. for their courtesy in loaning the stamps from which the illustrations for our stamp pages have been made.

Solutions to January Puzzles

No. 1. The "Comet" was the first aeroplane in the square. To solve the puzzle properly it was necessary to start with this in the bottom right-hand corner and move diagonally upwards. The second aeroplane was the "Atalanta." To get the first letter of this it was necessary to go down one from the T in "Comet." The other aeroplanes, were in the following order: Courier, Heracles, Scylla, Hawk, Mew Gull, Fury, Monospar, Dragon, Hart, Cadet, Swift, Bulldog, Scipio. Vildebeest.

No. 2. The verse was from one of Tennyson's poems. With the vowels filled in it reads:

The splendour falls on castle walls
Any snowy summits old in story;
The long light shakes across the lakes,
And the wild cataract leaps in glory.
Blow bugle, blow, set the wild echoes flying,
Blow, bugle; answer echoes, dying, dying, dying.

No. 3. The three objects illustrated were Swing, Berry and Sign, the two letters to be taken from each word being *in italics*. When re-arranged these six letters make the name Singer.

No. 4. The five towns were: 1. Bolton; 2. Winchester; 3. Newcastle; 4. Shrewsbury; 5. Lancaster.

No. 5. "They also serve who only stand and wait," from Milton's sonnet "On his Blindness," was the line of verse hidden in this sentence.

No. 6. The proverb was: "A rolling stone gathers no moss."

No. 7. The magic square was:

ECHO
CHIP
HIRE
OPEN

No. 8. "Noon" is the word that reads the same backwards, forwards and upside-down.

No. 9. The words in this puzzle were: 1. Slumber. 2. Crown. 3. Ann. 4. O! 5. Ass. 6. Tapir. 7. Revalue. 8. Clearance.

The aeroplane was the "Monospar."

No. 10. The best way to solve this puzzle is to let x represent the age of Henry when John was three times as old as he was. John was then 3x years old and when Henry is three times as old as John was then, his age will be 9x years.

When John was half this age he was $4\frac{1}{2}$x years old and as John is always 2x years older than Henry, at this time Henry's age was $2\frac{1}{2}$x years.

As John is twice as old as this his age is 5x years while Henry's age is 3x years.

From this we get the equation $5x+3x=44$.

$x=5\frac{1}{2}$ years and thus John is $27\frac{1}{2}$ years old and Henry $17\frac{1}{2}$ years.

No. 11. The numbers 1 to 7 should be arranged in the following order:

1
2
34
6
57
100

Chemistry—(*Continued from page 101*)

them is a semi-circular steel flume, 10 ft. in diameter, along which the incoming sea water flows. Each unit consists of a blowing-out tower, in which the bromine is set free, and an absorption tower, in which it is taken up by the soda ash liquor.

The sea water is lifted by means of pumps to the tops of the blowing-out towers, and on the way the proportions of sulphuric acid and chlorine required to liberate the bromine are introduced through spec al valves. These towers are of brick, with concrete floors, and contain distributor boxes and pipes that divide the liquid into about 3,200 tiny streams that trickle downward through chambers filled with wood packing. There they meet strong air currents that blow the bromine out of them before they reach the bottom of the tower, and make their way into the outlet leading to the Cape Fear River.

The progress of the chemical changes taking place is carefully followed by means of automatic meters, and the valves that admit the sulphuric acid and the chlorine are adjusted by hand to ensure the best results. The acid is the first to be introduced, and before use is diluted to a strength of about 10 per cent. in rubber-lined tanks 16 ft. in diameter and 10 ft. in height. The chlorine is obtained from cylinders, each of which holds a ton of this element in liquid form, and reaches the sea water through a vapouriser consisting of a steam-jacketed iron pipe. It is probable that the operation of the valves admitting these chemicals also will be made automatic.

The air laden with bromine vapour from the blowing-out towers is drawn through the absorption towers by means of fans, and there meets a solution of soda ash that extracts the bromine. The absorption towers are built on concrete arches below which are the tanks in which the soda ash liquor is stored, and each is divided into nine chambers, down which the solution falls in the form of spray. The counter-current principle is followed, the air entering the towers meeting a solution that is almost saturated with bromine, and fresh soda ash liquor being used to extract the last ounce of bromine from the air leaving the towers.

The process is carried on without interruption, a stream of sea water flowing steadily through the blowing-out towers at a measured rate and bromine being driven out of it continuously, to be taken up by the soda liquor as this circulates through the absorbers. A mixture of sodium bromide and sodium bromate is the result, and the bromine is easily recovered by adding sulphuric acid to the liquor and blowing steam through it. The bromine vapour driven out in this manner is condensed into liquid form by cooling, exactly as in ordinary distillation.

The purpose of the plant is the production of a compound known as ethylene dibromide, one of the ingredients of the liquid that is added to petrol in order to prevent "knocking" in engines in which this fuel is used. It is formed when bromine is brought into contact with a gas called ethylene, that is produced in the plant on the Cape Fear River by passing the vapour of alcohol over heated kaolin, but is prepared in chemical laboratories by the action of sulphuric acid upon the same liquid. The effect is almost startling, for the gas transforms the evil smelling bromine into a heavy colourless liquid that has an attractive ethereal smell.

The manufacture of bromine from such unpromising raw material as sea water is a wonderful achievement. The process seems to give promise of even more astounding results, however, for a small globule of gold and silver has recently been extracted from the residues left after the separation of bromine. The recovery of these metals from the sea has always been one of the dreams of the chemist, but so far this has been unfulfilled because they are present in such minute proportion that enormous expense would be incurred in recovering them alone. The prospects of success seem brighter now that the valuable element bromine can be extracted at the same time, and it does not seem unreasonable to expect the chemist of the next decade to obtain gold from sea water on a commercial scale.

We are indebted to the Dow Chemical Company, Midland, Michigan, for valuable information in regard to the process described in this article.

Locomotive Turntables—(*Continued from page 91*)

reversed. After being pushed round 10 to 15 times, it will often spin through four or five revolutions unaided. The girders are next packed up, and the centre ball race and pivot extracted and inspected. If any flaws are found, the faulty part must be replaced.

The deflection produced by the load in the main girders is found as follows. At the centre, intermediate points, and ends of each girder, wood battens are fixed vertically with the edges in line. Pulleys are fastened to each girder end, and steel wires run over these—one wire on each side—and stretched taut by hanging weights. The position of the wire is next marked on each batten, and the loading commenced. After rotating the turntable under full load the position of the wire is again marked on the wood. The second mark will in each case be below the first, owing to the deflection of the steelwork under the load, and the distance between the two marks on each piece of wood represents the total deflection at the different points. The maximum deflection occurs at the ends and should be 5/16 in. to $\frac{3}{8}$ in. for a 50-ft. diameter turntable, $\frac{3}{8}$ in. to $\frac{1}{2}$ in. for a 60-ft. diameter, $\frac{1}{2}$ in. to $\frac{5}{8}$ in. for 70-ft. diameter, and $\frac{5}{8}$ in. to $\frac{3}{4}$ in. for 85-ft. and 100-ft. diameters, when under test. The actual deflection under working conditions will of course be slightly less, and can be obtained by taking measurements when weights equivalent to the working load are on the turntable.

The maximum value is of great importance, because it determines the position of the traverser wheels with relation to their track when the turntable is unloaded. The distance between the lower edge of a wheel and the top of the rail should be slightly less than the maximum deflection under the working load; if above or below this value, the wheels will either not touch the track at all, or will bear too heavily upon it.

Stamp advertisements continued from page 130

FINE STAMPS sent on approval at real bargain prices that will astonish you. Attractive selections of all countries. Everything from ¼d. "Space-Fillers" to high class items. State requirements. No Gifts. Prices from ⅓rd. to ⅛th Gibbons.—Campbell, Haldon Avenue, Teignmouth.

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APPROVALS. British Colonials, 25 Free. Send postage.—Hynds, 74, Swanage Road, Southend-on-Sea.

JUGO SLAVIA Collection, 50 all diff. 6d., 100 ditto, 1/6.—Sanders, 90, Newlands Avenue, Southampton.

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This offer includes new pictorials from British Guiana, Grenada, United States, etc. Absolutely FREE to all genuine applicants for approvals. Post paid both ways. **WILLIAMS, 7, ISLINGTON ROAD, TOWCESTER.**

New Year Bargains

The demand for New Year Bargains, featured on page 66 of the January Magazine, has been so great that stocks of most of the items are exhausted at the time of going to press. We are still able to supply the undermentioned, and will continue to execute orders until stocks are cleared.

These goods can only be obtained direct from Meccano Limited, Binns Road, Liverpool. They are not obtainable through Meccano dealers.

MECCANO AEROPLANE OUTFITS O.S.

	Price	Postage extra
No. 1 Aeroplane Outfit O.S.	4/6	9d.
No. 1a Aeroplane Outfit O.S.	4/3	9d
No. 2 Aeroplane Outfit O.S.	8/3	1/-

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M. Goods Train Set O.S.	4/3	9d.
No. 2 Passenger Train Set O.S. ...	25/-	1/3
No. 3C Pullman Train Set O.S. ...	31/3	1/9
M. Locomotive O.S.	1/6	4d.
No. O Locomotive O.S.	5/3	6d.
No. O/1 Tender O.S.	9d.	3d.
No. 2 Tender O.S.	1/9	6d.
No. 3 Tender O.S.	1/9	6d.

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No. 2 Wine Wagon O.S.	2/3	4d.
Bitumen Tank Wagon "Colas" O.S. ...	1/9	4d.
No. 2 Buffer Stops O.S.	2/9	4d.
No. 1 Lamp Standard O.S.	1/9	6d.
No. 2 Lamp Standard O.S.	2/3	6d.
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NOTE: The buffer height of the Locomotives and Rolling Stock listed above is 1-3/16 in. All orders will be executed in the railway lettering that is available.

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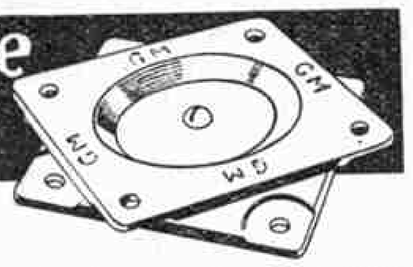

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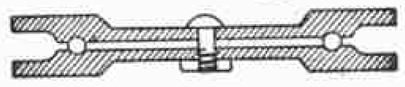

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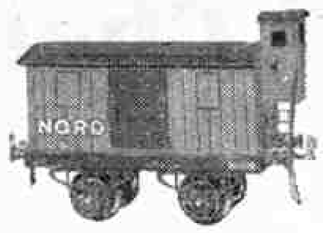

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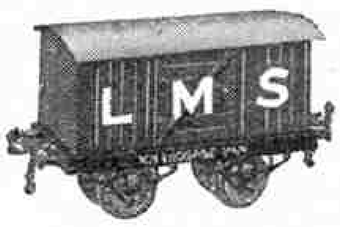

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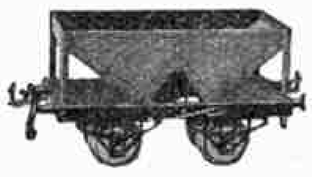
With opening doors. Price 2/9

CARR'S BISCUIT VAN
Finished in blue, with opening doors. Price 2/9



***HOPPER WAGON**
Mechanically unloaded. Finished in green. Price 3/6

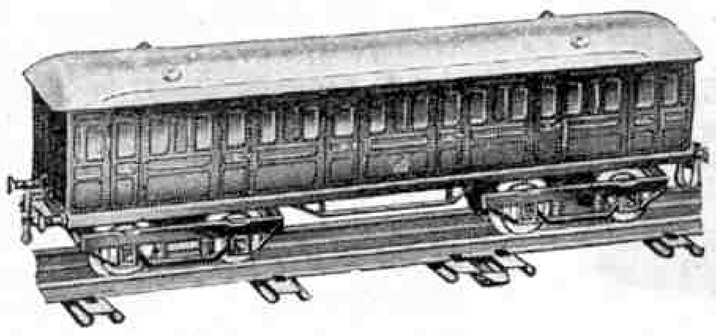
JACOB'S BISCUIT VAN
Finished in brown, with opening doors. Price 2/9

PETROL TANK WAGON "REDLINE-GLICO"
Finished in blue and red. Price 2/-

***FLAT TRUCK**
Without Cable Drum. Price 1/6
Complete with Cable Drum ... Price 1/9

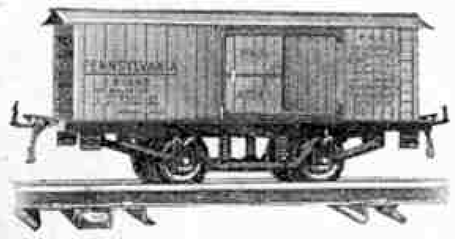
CABLE DRUM
(British Insulated Cables Ltd.) ... Price 3d.

TIMBER WAGON No. 1
Beautifully finished. Price 1/6



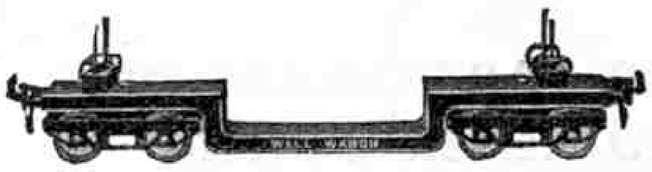
COACH, METROPOLITAN C
As supplied with Metropolitan Clockwork Train Set ... ... Price 7/6

COACH, METROPOLITAN LV
As supplied with E36 Metropolitan Electric Train Set ... Price 11/6

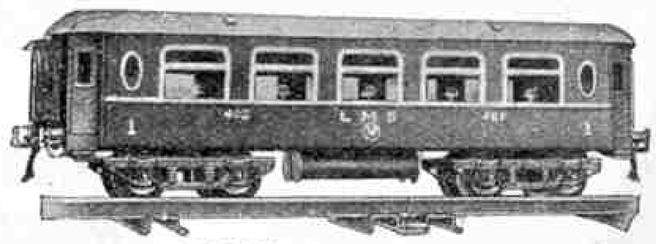


BOX CAR, AMERICAN TYPE
This is a model of the type in use on American railways. Price 2/6

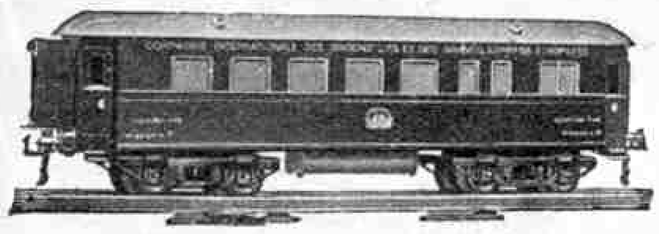
TARPAULIN SHEETS
Lettered L.M.S., G.W., N.E. or S.R. For fitting to Hornby Wagons. Price 2d.



TROLLEY WAGON
Finished in red and green. Suitable for 2-ft. radius rails only ... ... Price 3/11

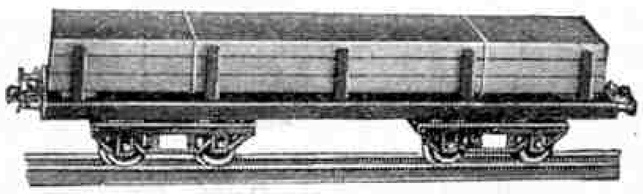


COACH, No. 2 SALOON
Realistic model. Beautifully finished in correct colours of L.M.S.R. or L.N.E.R. Saloon Coaches. Suitable for 2-ft. radius rails only ... Price 9/6

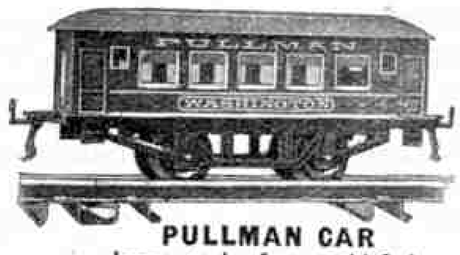


COACH, RIVIERA "BLUE"
"Dining" or "Sleeping"
This is a beautiful model, substantially built and well finished. Suitable for 2-ft. radius rails only. Price 12/6

COACH, CONTINENTAL "MITROPA" No. 3
Similar in design to the above. Beautifully finished in red with white roof, and lettered "Mitropa" in gold ... ... Price 12/6



TIMBER WAGON No. 2
Beautifully enamelled in green and red. Suitable for 2-ft. radius rails only ... ... Price 2/6

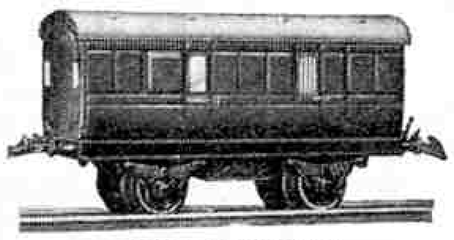


PULLMAN CAR
Imported from U.S.A. Product of Meccano factories.

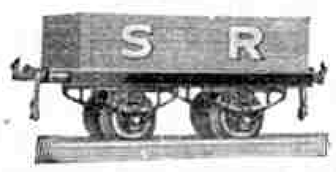
American Type (as illustrated). Yellow or green, with orange or bright red roof. Lettered "Washington" or "Madison" ... Price 1/6

Continental Type. Red with white roof. Lettered "Mitropa" No. O. Price 1/6

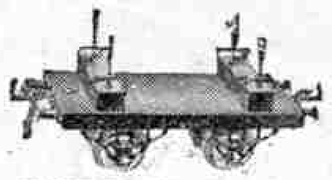
BRAKE VAN
Finished in brown, with opening doors. Obtainable with N.E. or S.R. lettering. Price 2/11



GUARD'S VAN
In colours to represent L.M.S.R., L.N.E.R., G.W.R. or S.R. Price 2/6

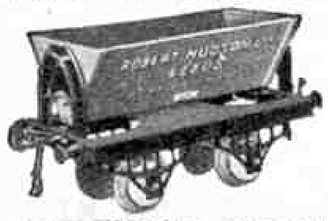


***WAGON, HORNBY No. 0** ... Price 1/6
***WAGON, HORNBY No. 1** (illustrated) Price 1/9



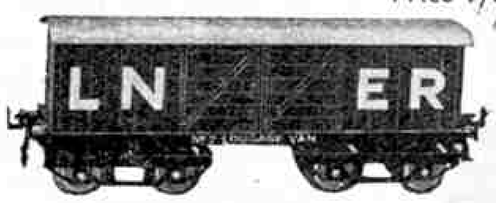
LUMBER WAGON No. 1
Fitted with bolsters and stanchions. Price 1/6

SNOW PLOUGH
With revolving plough. Price 3/9

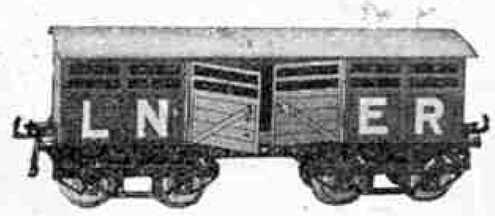


SIDE TIPPING WAGON
Lettered "Robert Hudson Ltd." Price 2/-

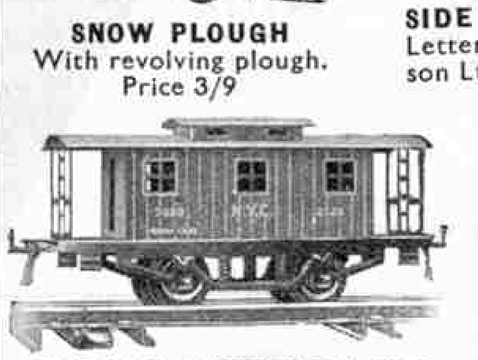
TANK CAR, AMERICAN TYPE
Model of the type of oil tank car used in America ... Price 1/9



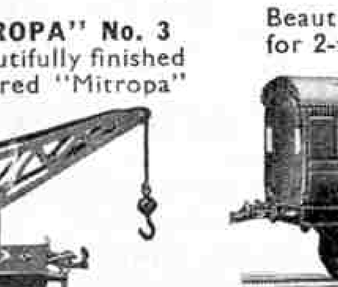
***LUGGAGE VAN No. 2**
Fitted with double doors. Suitable for 2-ft. radius rails only. Price 4/6



***CATTLE TRUCK No. 2**
Fitted with double doors. Suitable for 2-ft. radius rails only ... Price 4/6



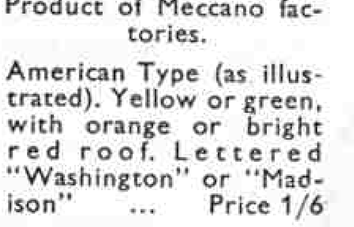
CABOOSE, AMERICAN TYPE
Modelled on the type of brake van used on American railways. Price 2/6



WAGON, COVERED (French Type)
This wagon is fitted with frame and sheet. Lettered "NORD" ... Price 2/6

MILK TANK WAGON "UNITED DAIRIES"
Finished in blue and white. Price 4/6

CEMENT WAGON
The door at the top opens. Finished in bright red. Price 2/6



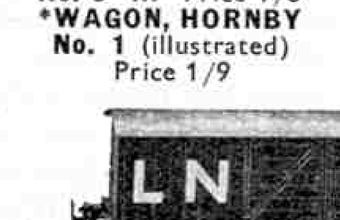
CHOCOLATE VAN "CADBURY'S"
Beautifully finished in blue with white roof. Price 2/9

CRANE TRUCK
Finished in brown and blue. Price 2/11

BITUMEN TANK WAGON "COLAS"
Finished in blue Price 3/6

BARREL WAGON
This is a model of a type of wagon used in France and other European countries. Price 2/6

WAGON (French Type)
Lettered "NORD." Price 3/3



WINE WAGON DOUBLE BARREL
This model represents the French double-barrel type of Wine Wagon. Beautiful finish. Price 4/6

WINE WAGON SINGLE BARREL
Price 3/6

ROTARY TIPPING WAGON No. 0
Price 1/6

ROTARY TIPPING WAGON No. 1
Finished in blue and pale gold ... ... Price 2/6

In L.M.S.R., L.N.E.R., G.W.R., or S.R. lettering.

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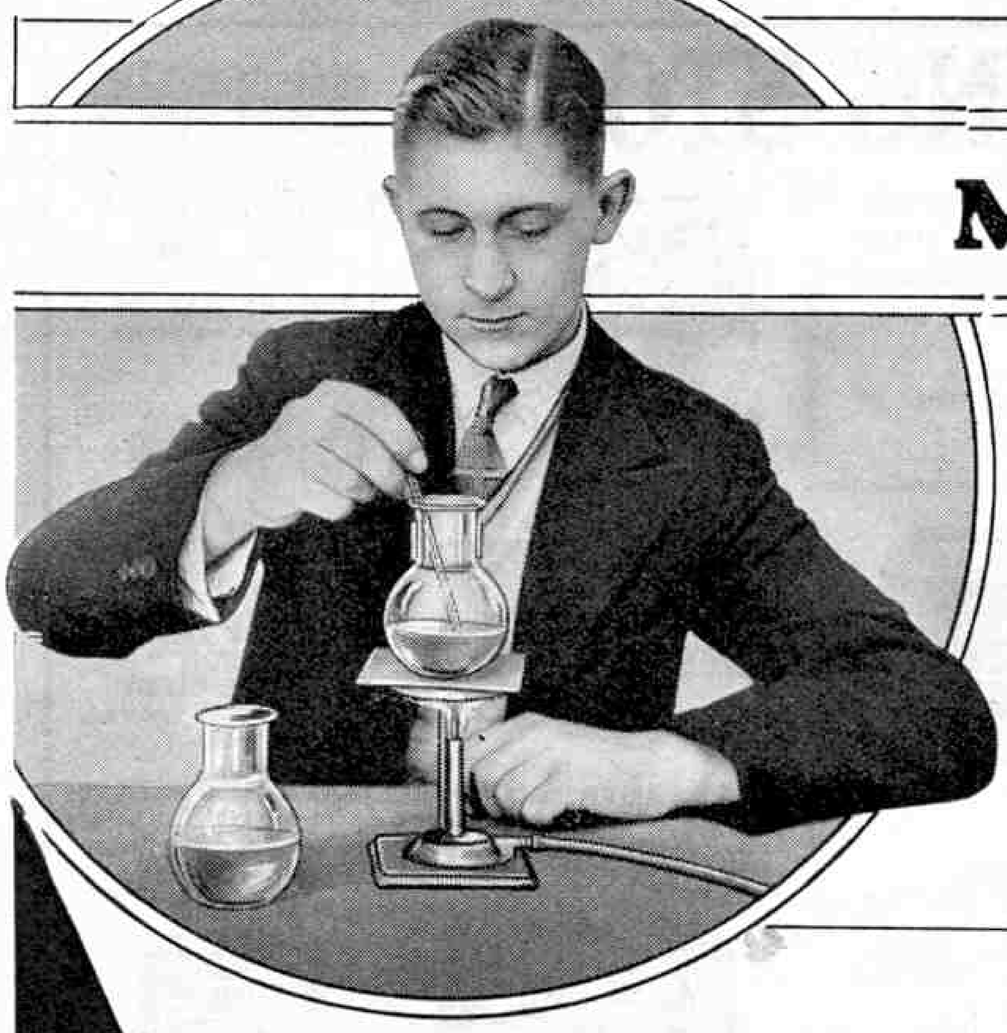

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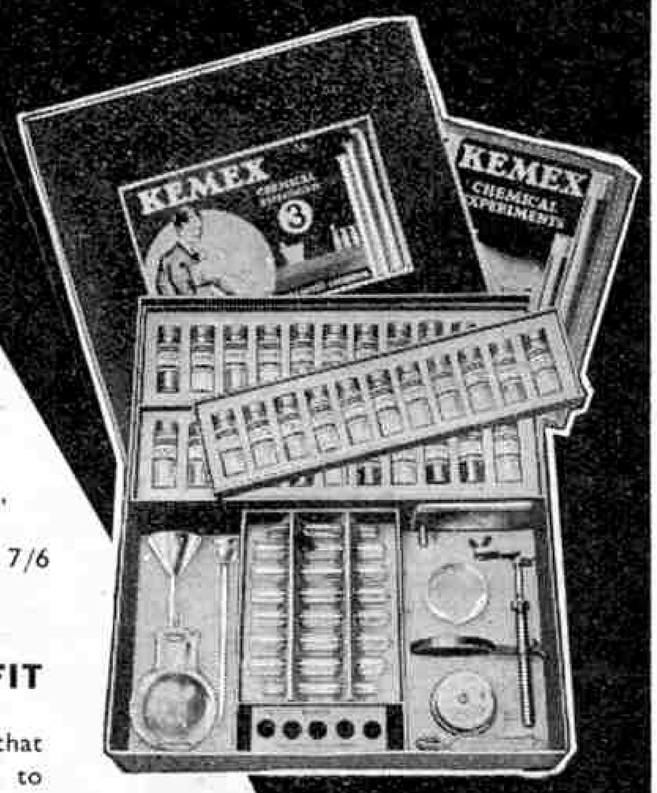

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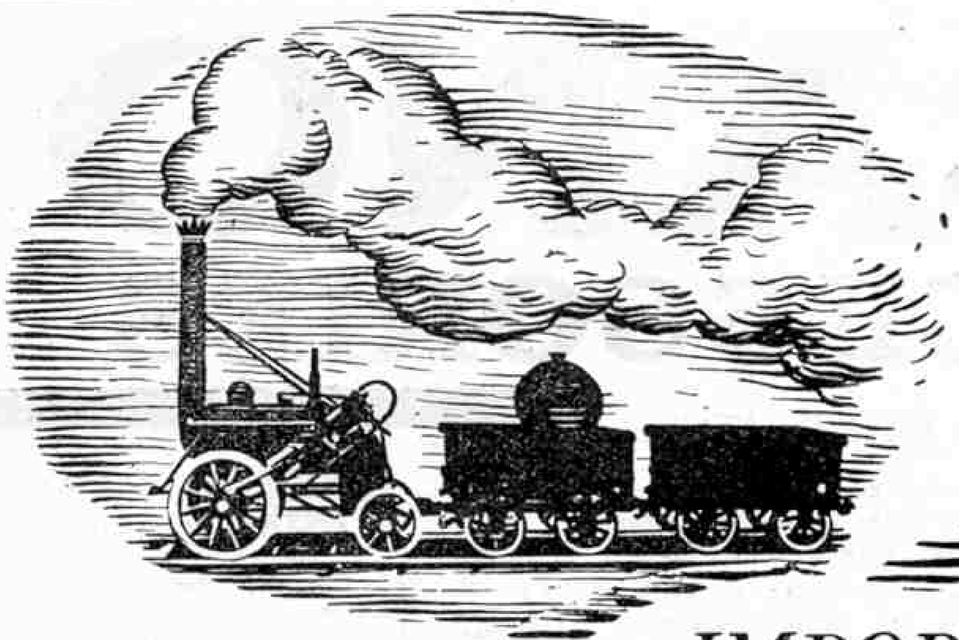

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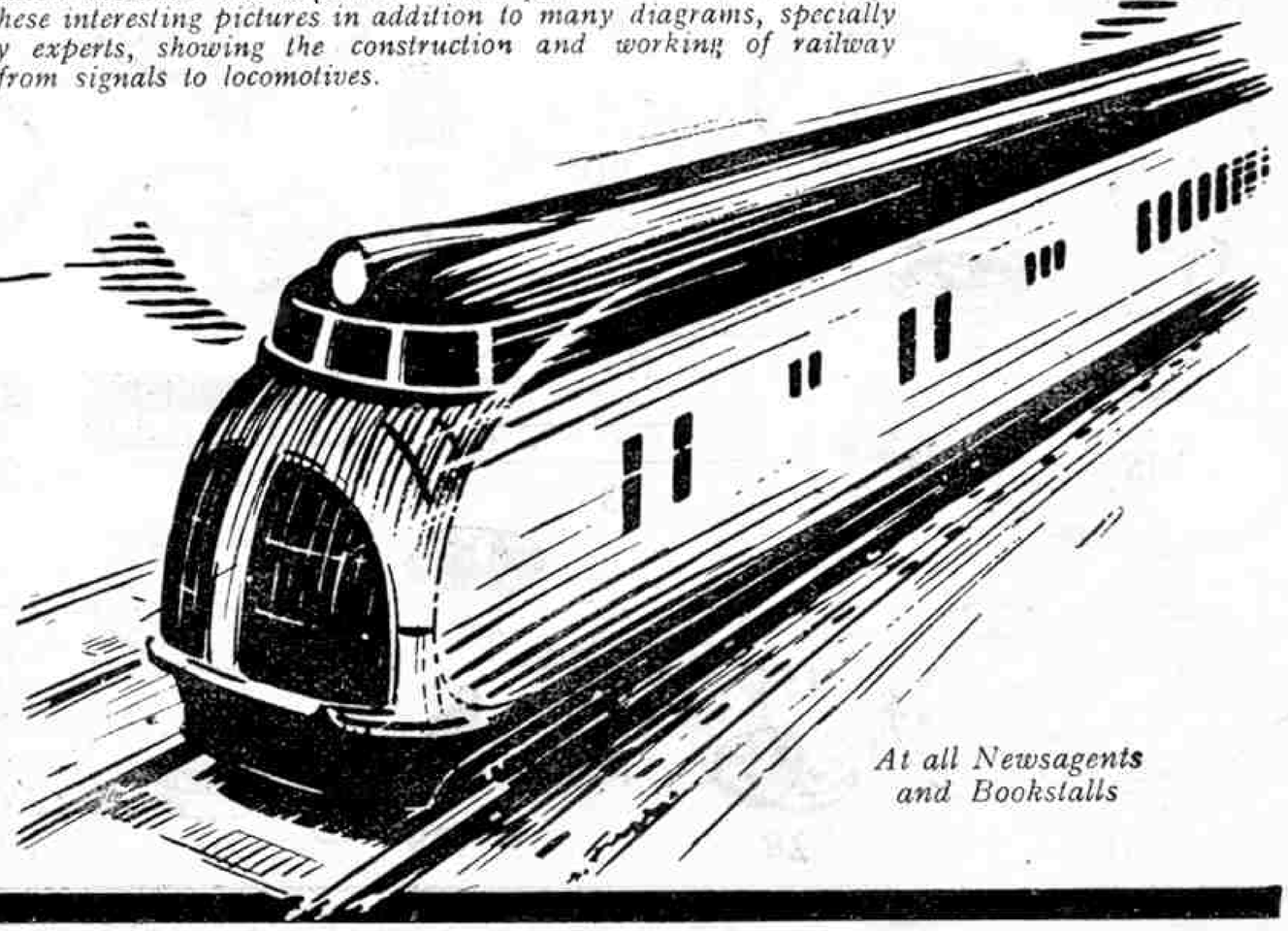

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19a.	Wheels, 3" diam., with set screws	each	0	6
20.	Flanged Wheels, 1½" diam.	,,	0	5
20b.	,, ,, ¾"	,,	0	3
	Pulley Wheels			
19c.	6" dia. with centre boss and set screw	each	1	9
20a.	2" ,, ,,	,,	0	4
21.	1½" ,, ,,	,,	0	4
22.	1" ,, ,,	,,	0	3
23a.	½" dia. with centre boss and grub screw	,,	0	3
22a.	1" dia. without centre boss and grub screw	,,	0	2
23.	½" ,, ,,	,,	0	2
24.	Bush Wheels	,,	0	4
26.	Pinion Wheels, ½" dia., ¼" face	,,	0	4
26a.	,, ,, ½" ,, ½"	,,	0	5
26b.	,, ,, ½" ,, ¾"	,,	0	6
	Gear Wheels			
27.	50 teeth to gear with ¾"-pinion	each	0	5
27a.	57 ,, ,, ,, ½"	,,	0	6
28.	Contrate Wheels, 1½" diam.	,,	0	9
29.	,, ,, ¾"	,,	0	6
30.	Bevel Gears, ¾", 26 teeth	,,	0	7
30a.	,, ,, ½", 16 ,,	,,	0	6
30c.	,, ,, 1½", 48 ,,	,,	1	6
	(30a and 30c can only be used together)			
31.	Gear Wheels, 1", 38 teeth	each	0	10
32.	Worms	,,	0	4
44.	Cranked Bent Strips	,,	0	1
45.	Double ,, ,,	,,	0	1
46.	,, Angle Strips, 2½" x 1"	½ doz.	0	6
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95b.	Sprocket Wheels, 56 teeth, 3" diam.	,,	0	6
96.	Sprocket Wheels, 18 teeth, 1" diam.	,,	0	3
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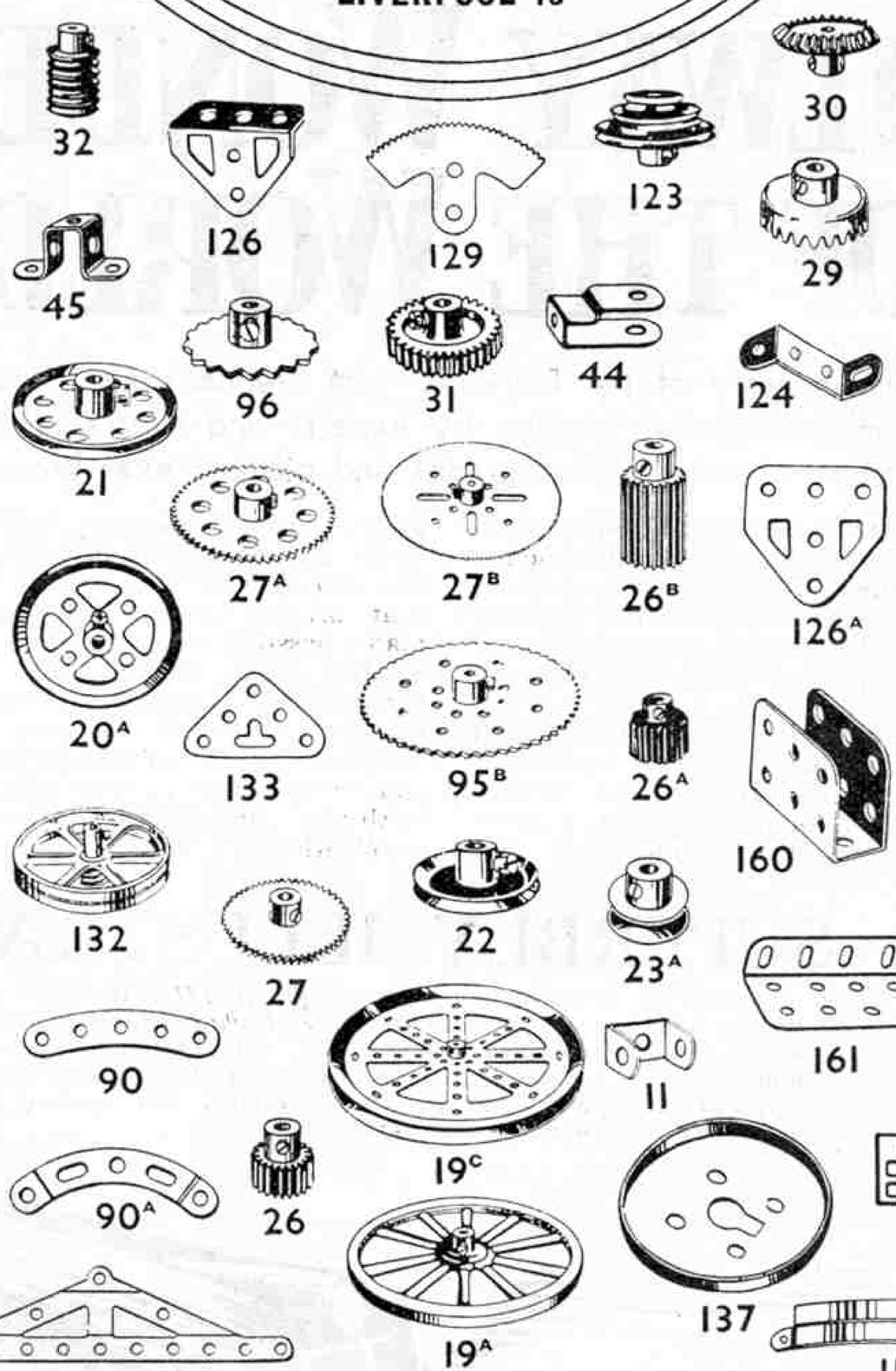
102.	Single Bent Strips	each	0	1
103d.	Flat Girders, 3½" long	½ doz.	0	7
108.	Architraves	doz.	1	6
110.	Rack Strips, 3½"	each	0	2
113.	Girder Frames	,,	0	3
118.	Hub Discs, 5½"	,,	1	3
119.	Channel Segments (8 to circle, 11½" diam.)	,,	0	4
123.	Cone Pulley	,,	1	3
124.	Reversed Angle Brackets, 1"	½ doz.	0	4
125.	,, ,, ½"	,,	0	3
126.	Trunnions	pair	0	3
126a.	Flat Trunnions	each	0	1
129.	Rack Segments, 3" diam.	,,	0	5
132.	Flywheels, 2¾" diam.	,,	2	0
133.	Corner Brackets, 1½"	,,	0	1
133a.	,, ,, 1"	,,	0	1
137.	Wheel Flanges	,,	0	3
139.	Flanged Brackets (right)	,,	0	2
143.	Circular Girders, 5½" diam.	,,	1	0
145.	Circular Strips, 7½" diam. over all	,,	0	9
147.	Pawls, with Pivot Bolt and nuts	,,	0	3
148.	Ratchet Wheels	,,	0	6
154a.	Corner Angle Brackets, ½", right hand	½ doz.	0	6
154b.	Corner Angle Brackets, ½", left hand	,,	0	6
160.	Channel Bearings, 1½"x 1"x ½"	each	0	2
161.	Girder Brackets, 2"x 1"x ½"	2 for	0	3
167	Geared Roller Bearings	each	20	0
168.	Ball Bearings, 4" diam.	,,	3	0
170.	Eccentrics, ¼" throw	,,	0	9
180.	Toothed Gear Ring, 3½" diam. 133 external teeth / 95 internal ,,	,,	2	0



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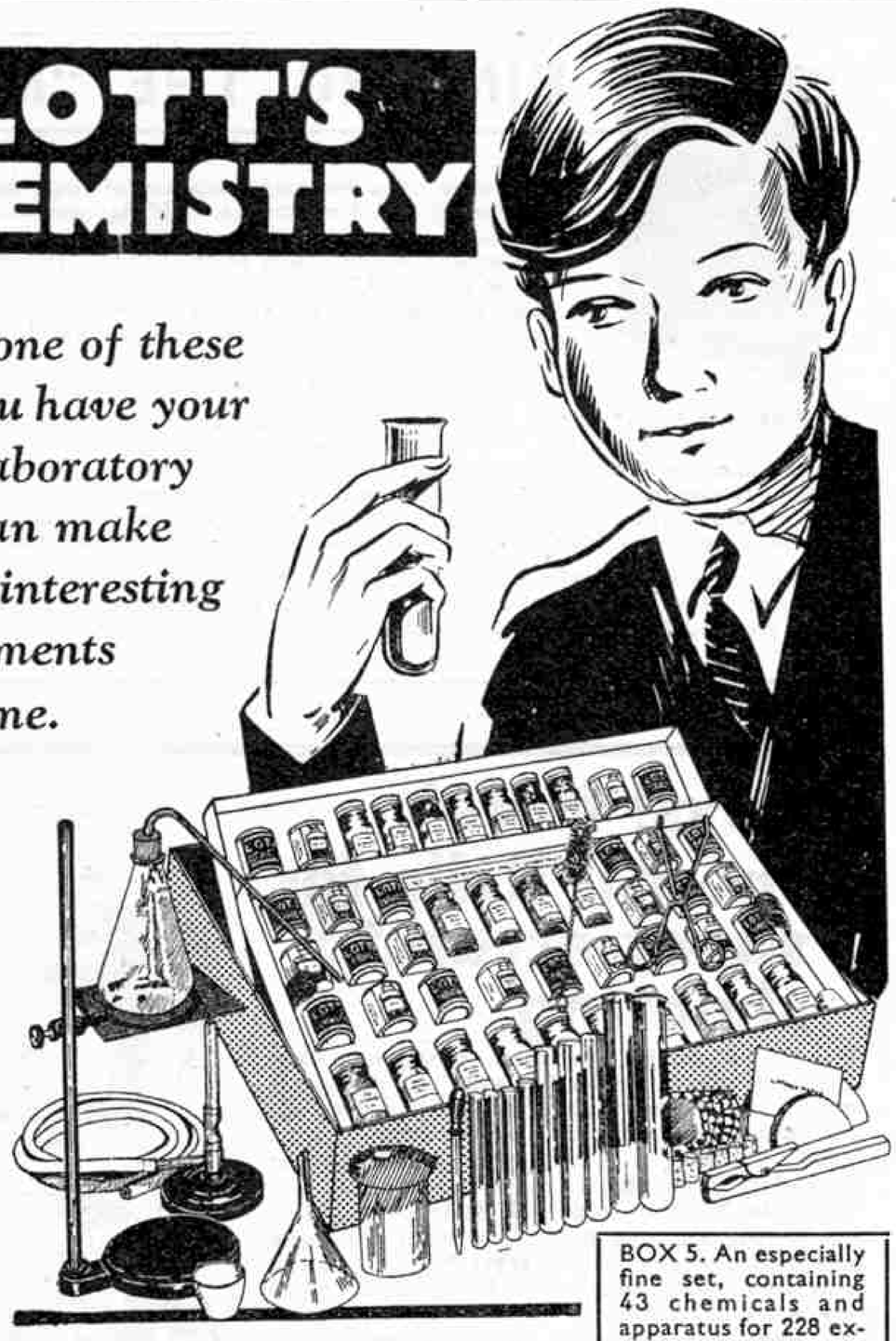

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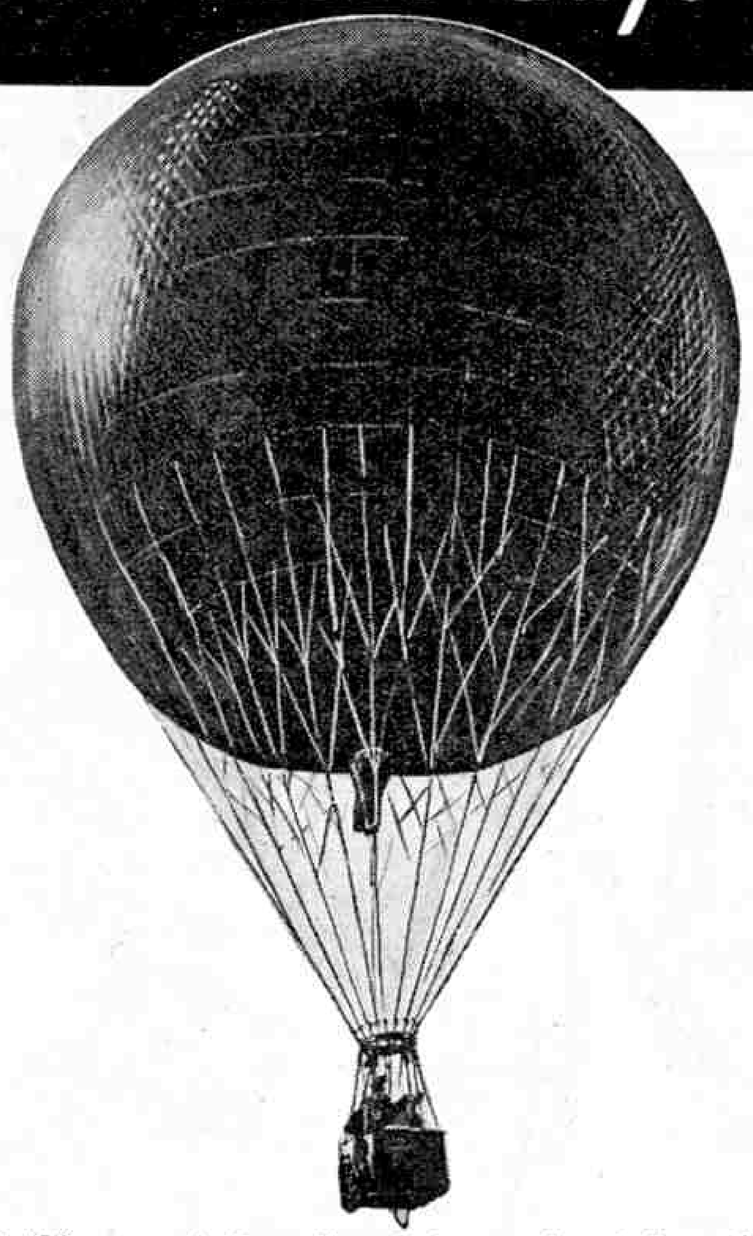
Flying meant BALLOONS in those days



In 1884 (20 years before the first aeroplane) Seccotine was discovered. Flying meant ballooning in those days. Yet though the world has since seen immense development in Air travel, Seccotine is still the standby for making and mending. It has been used on record-breaking long-distance 'planes, Schneider Trophy Seaplanes, by the Admiralty and leading factories and workshops everywhere, on jobs where failure to stick might mean disaster. The WORLD'S PROVED STRONGEST ADHESIVE.

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Binding 6 and 12 copies. These binding cases are supplied so that readers may have their Magazines bound locally, but where desired, the firm mentioned above will bind Meccano Magazines at a charge of 5/9 for six issues or 7/6 for twelve issues, including the cost of the binding and also return carriage The covers of the Magazines may be included or omitted as required, but in the absence of any instructions to the contrary they will be included.

Whilst the binding of the twelve Magazines is quite satisfactory, they form a rather bulky volume and for that reason arrangements have been made to bind six months' Magazines where so desired, as explained above.

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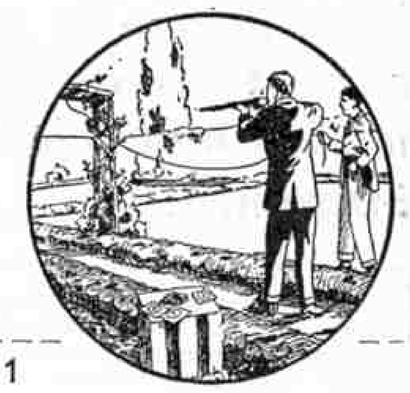

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- Noteheadings
- Visiting Cards
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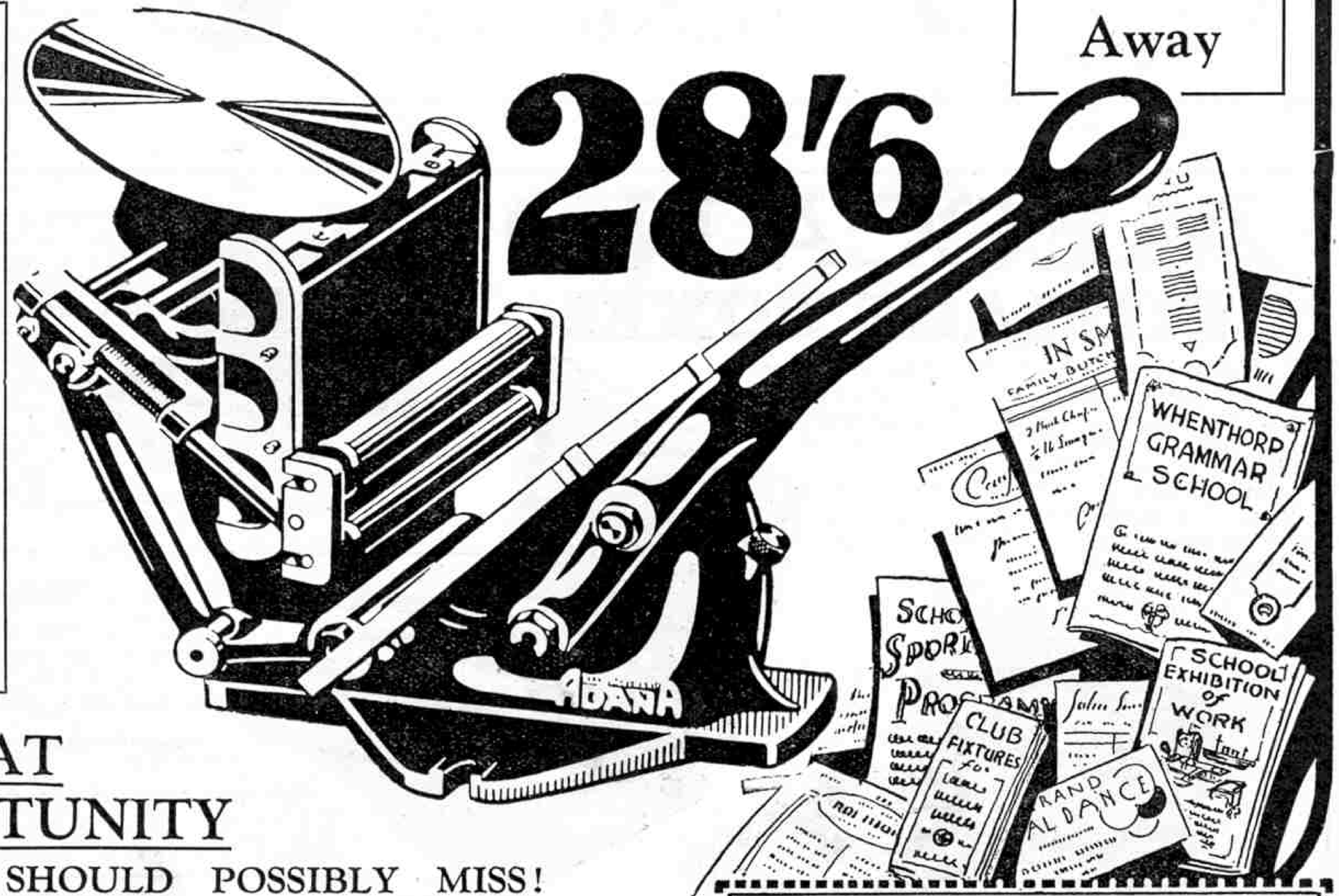
- Etc., Etc.



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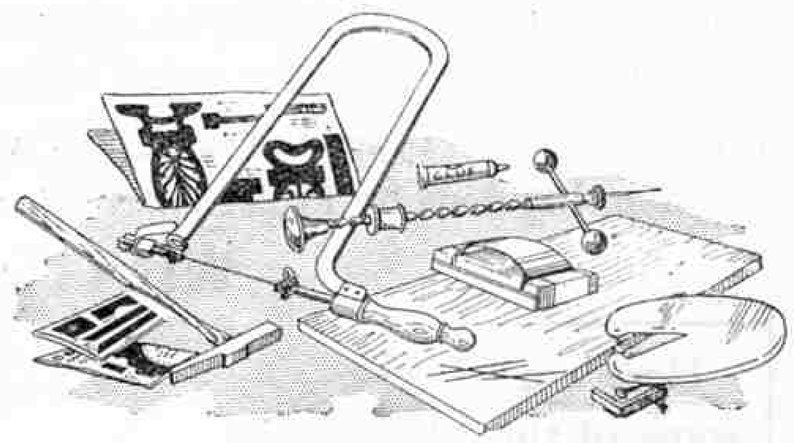
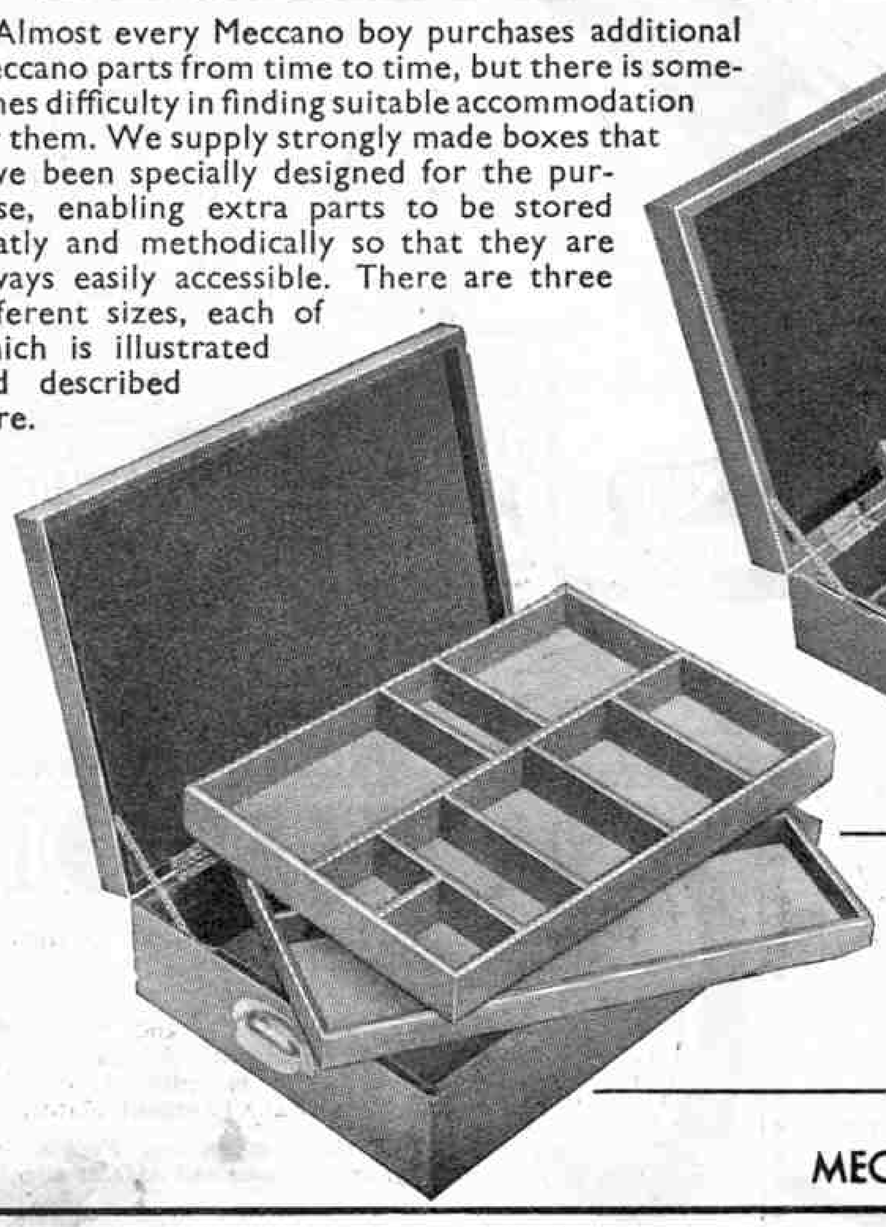


MECCANO STORAGE BOXES

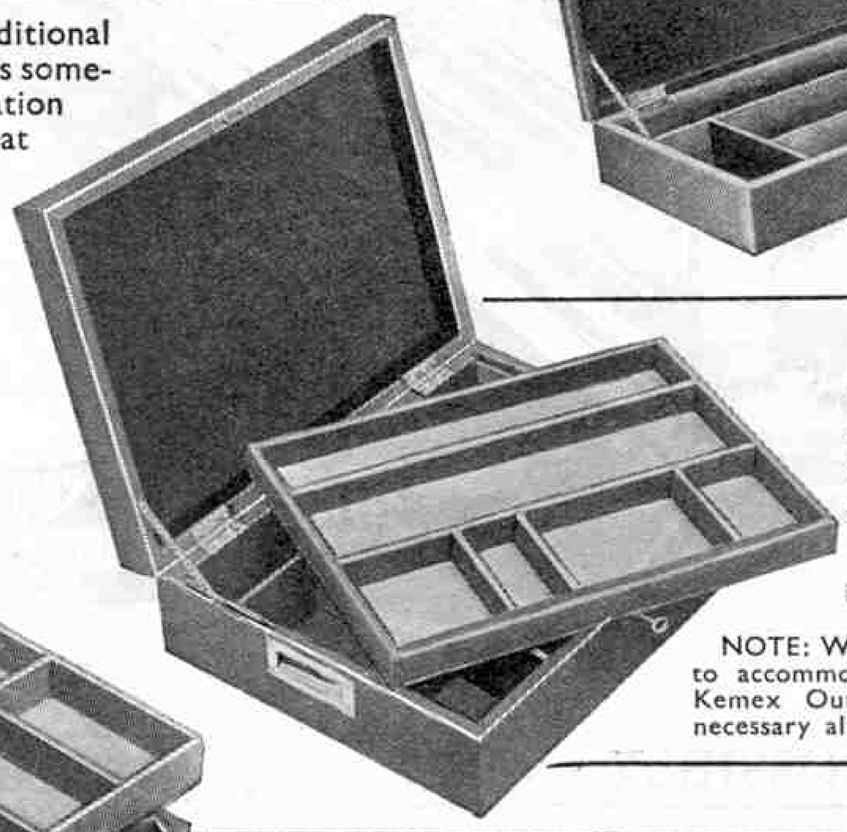
Almost every Meccano boy purchases additional Meccano parts from time to time, but there is sometimes difficulty in finding suitable accommodation for them. We supply strongly made boxes that have been specially designed for the purpose, enabling extra parts to be stored neatly and methodically so that they are always easily accessible. There are three different sizes, each of which is illustrated and described here.



No. 1 STORAGE BOX

This Storage Box is attractively finished in colour, and is fitted with partitions. Two special snap fasteners are used to secure the lid instead of the lock and key shown in the illustration.

Dimensions: Length 15½ ins. Width 8¾ ins. Depth 2¾ ins. Price **6/—**



No. 2 STORAGE BOX

No. 2 Storage Box is tastefully finished in red. The partitioned tray with which it is fitted enables a large quantity of parts to be accommodated.

Dimensions: Length 14½ ins. Width 11 ins. Depth 3¾ ins. Price **10/—**

NOTE: With slight modifications this box can be made to accommodate the contents of the No. 3 Meccano Kemex Outfit. We are prepared to undertake the necessary alterations at an extra charge of 2/6.

No. 3 STORAGE BOX

No. 3 Storage Box is a perfect receptacle for Meccano parts, strongly made and attractively finished in red. It is fitted with two brass handles, and the lid is secured by means of two snap fasteners. Two partitioned trays are included, as shown in the illustration.

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AND NOW ANOTHER

Actual Photograph of Hawker Hart. Wing Span 18⅛ ins.

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4. SCHNEIDER SEAPLANE	4/–	4/4	5/–
5. DE HAVILLAND "DRAGON" ...	7/6	8/–	8/9
6. DE HAVILLAND "FOXMOTH" ...	4/–	4/4	5/–
7. S.E.5a	3/6	3/10	4/6
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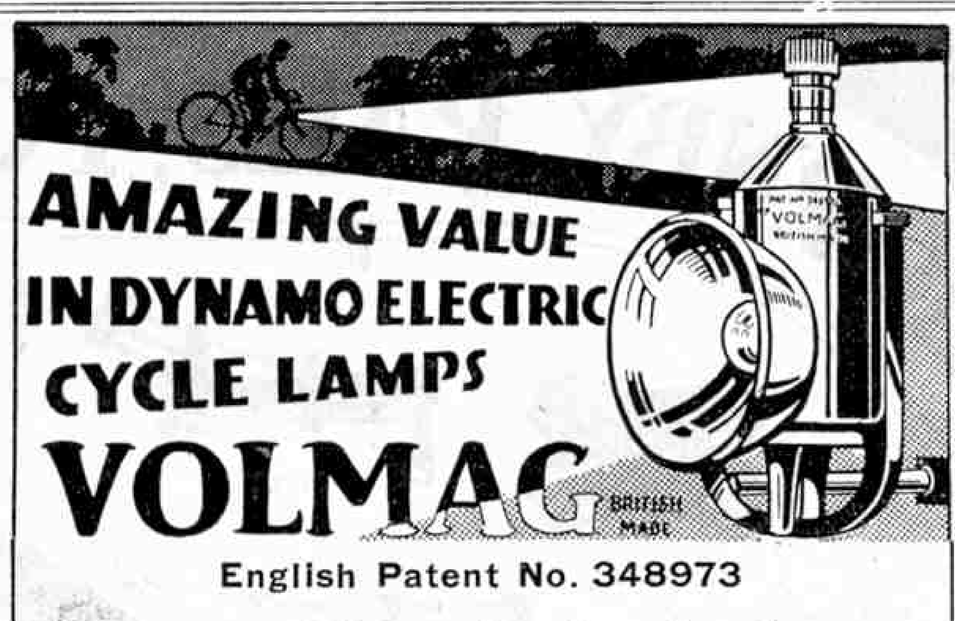

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No. VM/76 with large silver-plated reflector (dia. 2¾"), **7/6 post free.**

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Skybird and Shipseries parts are not toys, but are accurate, engineer-made, true-to-scale and complete in all details. They are of wood, metal and celluloid; not cardboard. There is a complete range of parts, for both Aeroplanes and Ship models, for you to build. As a hobby, it is the most fascinating in the world.

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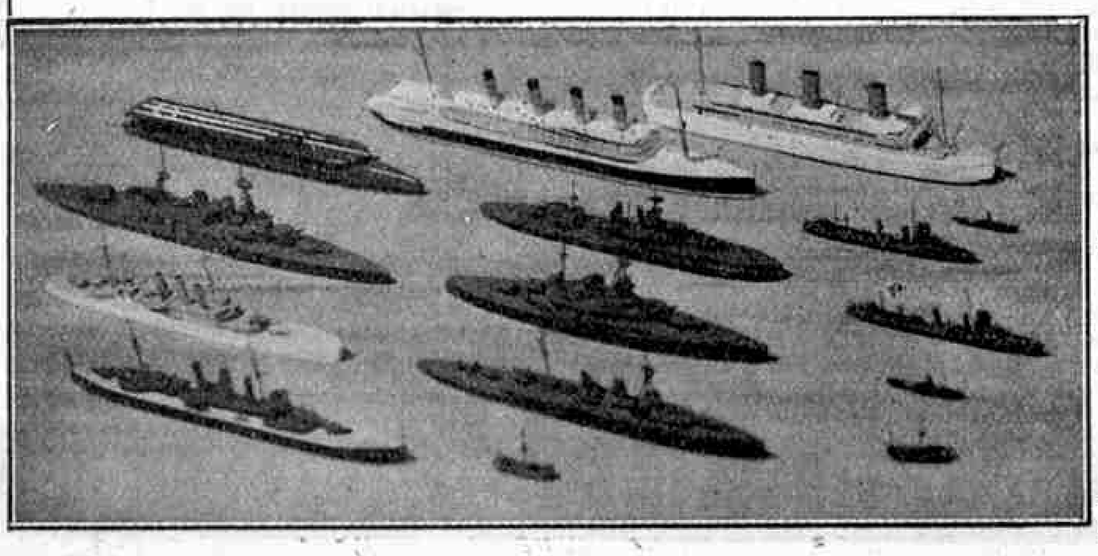
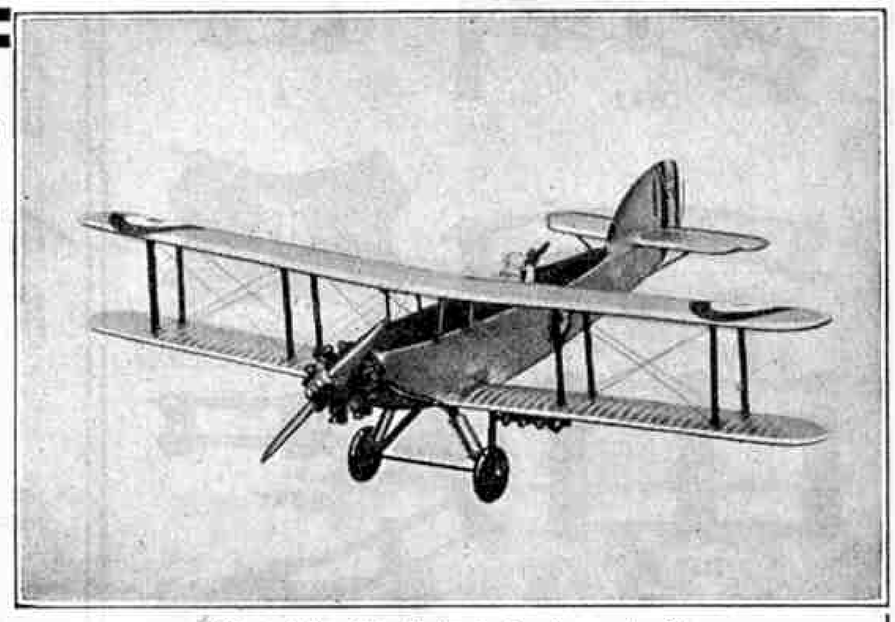


SKYBIRD LEAGUE

SHIPSERIES LEAGUE



The set for this Fairey Gordon costs 3/–

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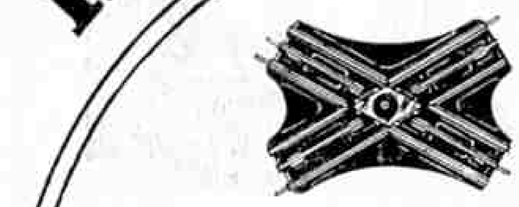
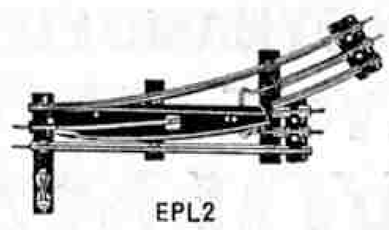
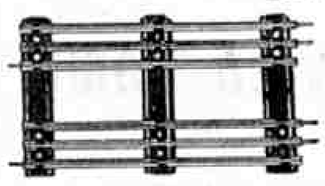
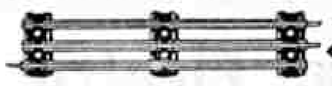
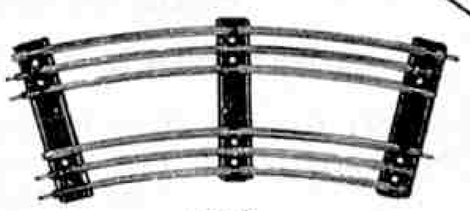

ECA


EPL2

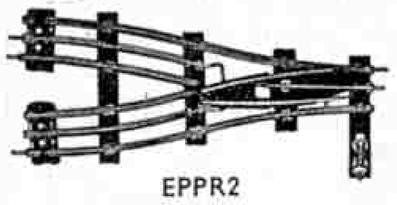
EA2½

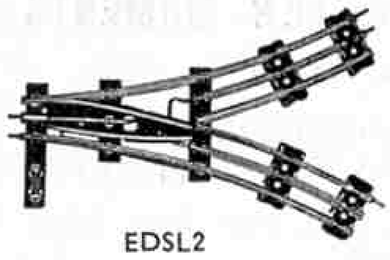

EDS1

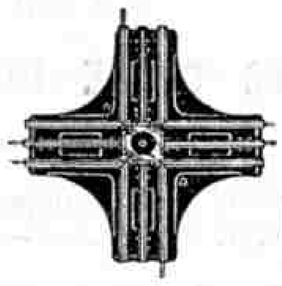

EB1

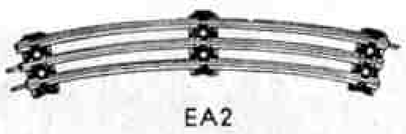

EDC2

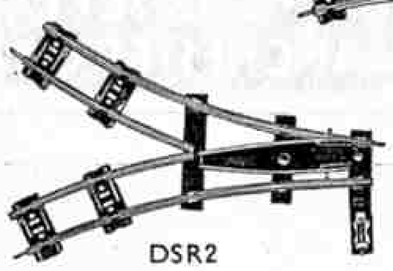
EB¼

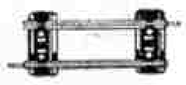

EPPR2


EDSL2

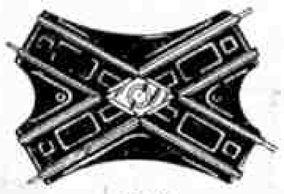

ECR

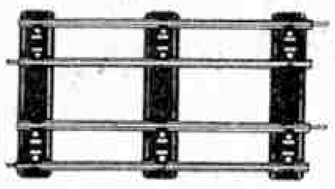

EA2

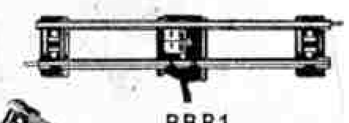

DSR2

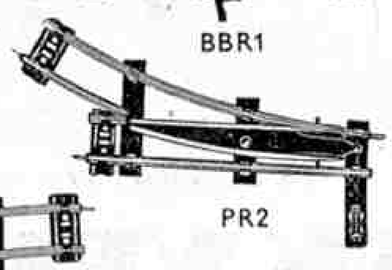

B½

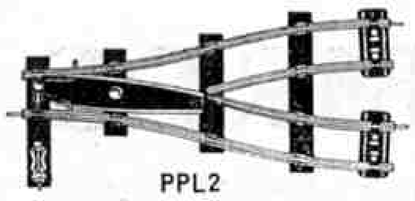
A2


CA2

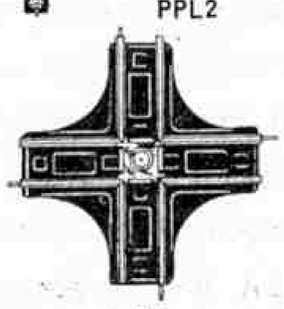

DS1

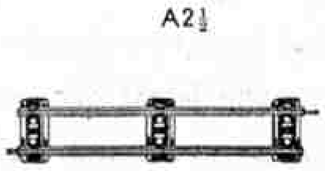

BBR1

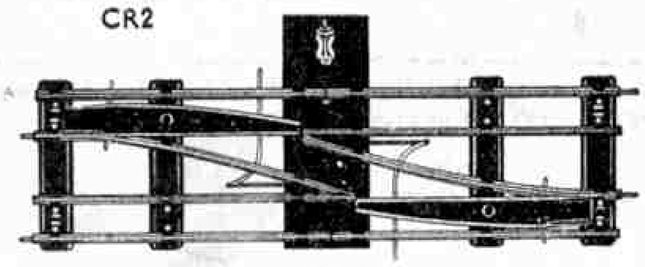

PR2

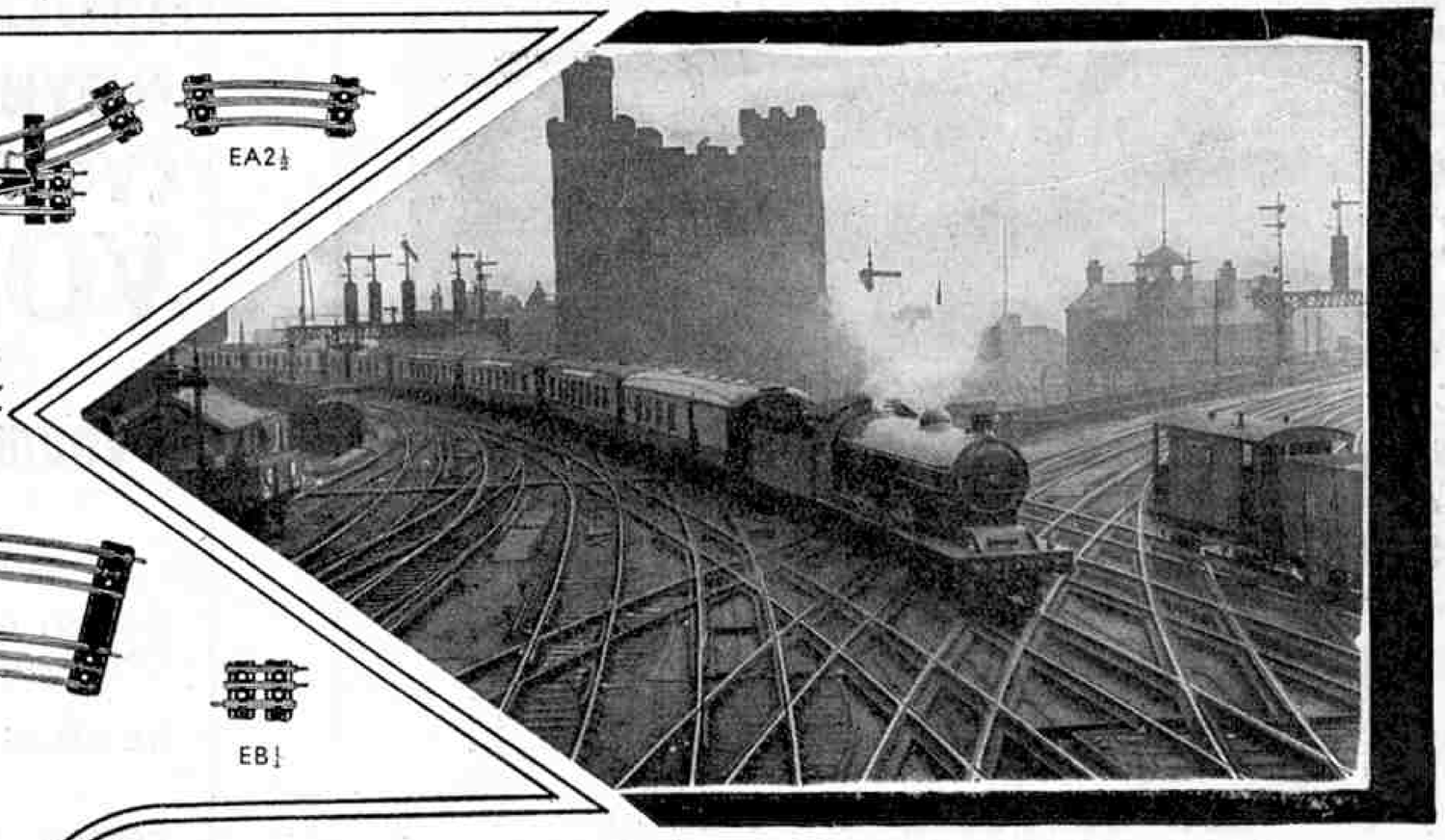

PPL2

A2½


CR2


B1


COR2



There is practically no limit to the number of rail formations that can be built with Hornby Rails, Points and Crossings. A supply of Rails is included in every Hornby Train Set, but the owner is certainly not getting the best out of his set if he is satisfied with merely running it round a simple oval track. The addition of extra Rails and of Points and Crossings to his equipment lends a delightful realism to the game and greatly enhances the fun.

Rails for Electric Trains, Gauge 0, 1¼"

CURVED RAILS

1-ft. Radius

EA1	Curved rails	per doz.	5/–
EA1½	Curved half rails	,,	4/6
EA1¼	Curved quarter rails	,,	4/–

2-ft. Radius

EA2	Curved rails	per doz.	5/–
EA2½	Curved half rails	,,	4/6
EA2¼	Curved quarter rails	,,	4/–
EDC2	Curved rails, double track ...	½ doz.	9/–

STRAIGHT RAILS

EB1	Straight rails	per doz.	5/–
EB½	Straight half rails	,,	4/6
EB¼	Straight quarter rails	,,	4/–
EDS1	Straight rails, double track ...	½ doz.	8/6

POINTS

For 1-ft. Radius Curves

EPR1	Right-hand points }	per pair	5/9
EPL1	Left-hand points }		

For 2-ft. Radius Curves

EPR2	Right-hand points }	per pair	6/6
EPL2	Left-hand points }		

CROSSINGS

ECA	Acute-angle crossings	each	2/9
ECR	Right-angle crossings	,,	2/9

DOUBLE SYMMETRICAL POINTS

For 1-ft. Radius Curves

EDSR1	Double symmetrical points, right-hand,		
EDSL1	Double symmetrical points, left-hand,	per pair	6/–

For 2-ft. Radius Curves

EDSR2	Double symmetrical points, right-hand,		
EDSL2	Double symmetrical points, left-hand,	per pair	7/–

PARALLEL POINTS

EPPR2	Parallel points, right-hand }	per pair	7/–
EPPL2	Parallel points, left-hand }		

CROSSOVER POINTS

ECOR2	Crossover points, right-hand }	per pair	24/–
ECOL2	Crossover points, left-hand }		

EMC20	Switch rail (20-volt)	each	1/3
EMC6	Switch rail (6-volt)	,,	1/3
TCP6	Terminal connecting plates (6-volt)	,,	1/3
TCP20	Terminal connecting plates (20-volt)	,,	1/3

Rails for Clockwork and Steam Trains, Gauge 0, 1¼"

CURVED RAILS

9-in. Radius (for MO Trains)

M9	Curved rails	per doz.	2/6
MB9	Curved brake rails	each	3d.
A1	Curved rails (1-ft. Radius) ...	per doz.	3/6
A1½	Curved half rails ... ,, ...	,,	3/–
A1¼	Curved quarter rails ,, ...	,,	2/6
AB1	Curved brake rails ,, ...	each	4d.
A2	Curved rails (2-ft. Radius) ...	per doz.	3/6
A2½	Curved half rails ,, ...	,,	3/–
A2¼	Curved quarter rails ,, ...	,,	2/6
AB2	Curved brake rails ,, ...	each	5d.
DC2	Curved rails, double track ,, ...	½ doz.	6/–

STRAIGHT RAILS

BM	Straight rails (for MO Trains) ...	per doz.	2/6
B1	Straight rails	,,	3/6
B½	Straight half rails	,,	3/–
B¼	Straight quarter rails	,,	2/6
BB1	Straight brake rails	each	4d.
BBR1	Straight brake and reverse rails...	,,	1/6
DS1	Straight rails, double track ...	½ doz.	5/3

CROSSINGS

CA1	Acute-angle crossings (for 1-ft. radius tracks)	each	1/9
CA2	Acute-angle crossings (for 2-ft. radius tracks)	,,	1/6
CR1	Right-angle crossings (for 1-ft. radius tracks)	,,	1/9
CR2	Right-angle crossings (for 2-ft. radius tracks)	,,	1/6

POINTS

9-in. Radius (for MO Trains)

MR9	Right-hand points... ... }	per pair	3/–
ML9	Left-hand points ... ... }		

For 1-ft. Radius Curves

PR1	Right-hand points... ... }	per pair	3/–
PL1	Left-hand points ... ... }		

For 2-ft. Radius Curves

PR2	Right-hand points... ... }	per pair	3/–
PL2	Left-hand points ... ... }		
PSR2	Points on solid base, right-hand }	per pair	8/6
PSL2	Points on solid base, left-hand }		

PARALLEL POINTS

PPR2	Parallel points, right-hand }	per pair	3/6
PPL2	Parallel points, left-hand }		

DOUBLE SYMMETRICAL POINTS

For 1-ft. Radius Curves

DSR1	Double symmetrical points, right-hand,		
DSL1	Double symmetrical points, left-hand,	per pair	3/6

For 2-ft. Radius Curves

DSR2	Double symmetrical points, right-hand,		
DSL2	Double symmetrical points, left-hand,	per pair	3/6

CROSSOVER POINTS

COR2	Crossover points, right-hand }	per pair	12/–
COL2	Crossover points, left-hand }		
RCP	Rail connecting plates ...	½ doz.	2d.

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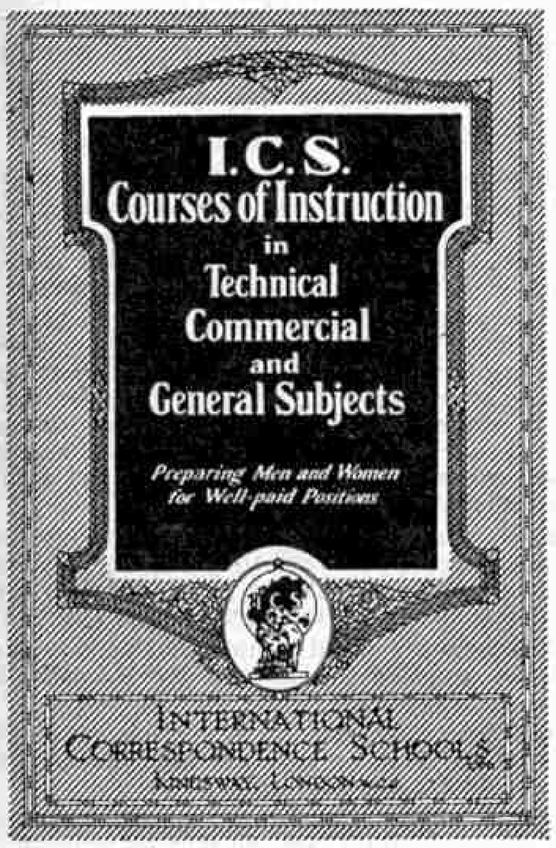

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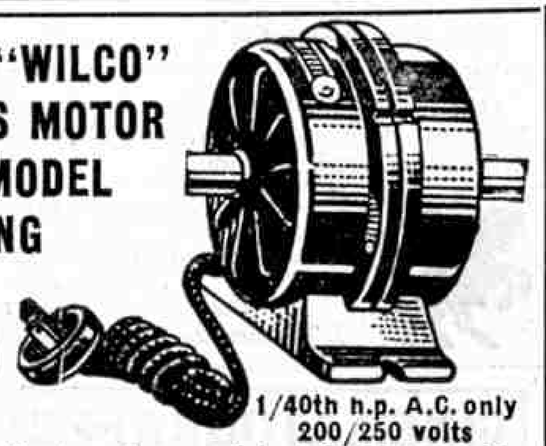

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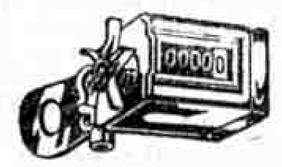

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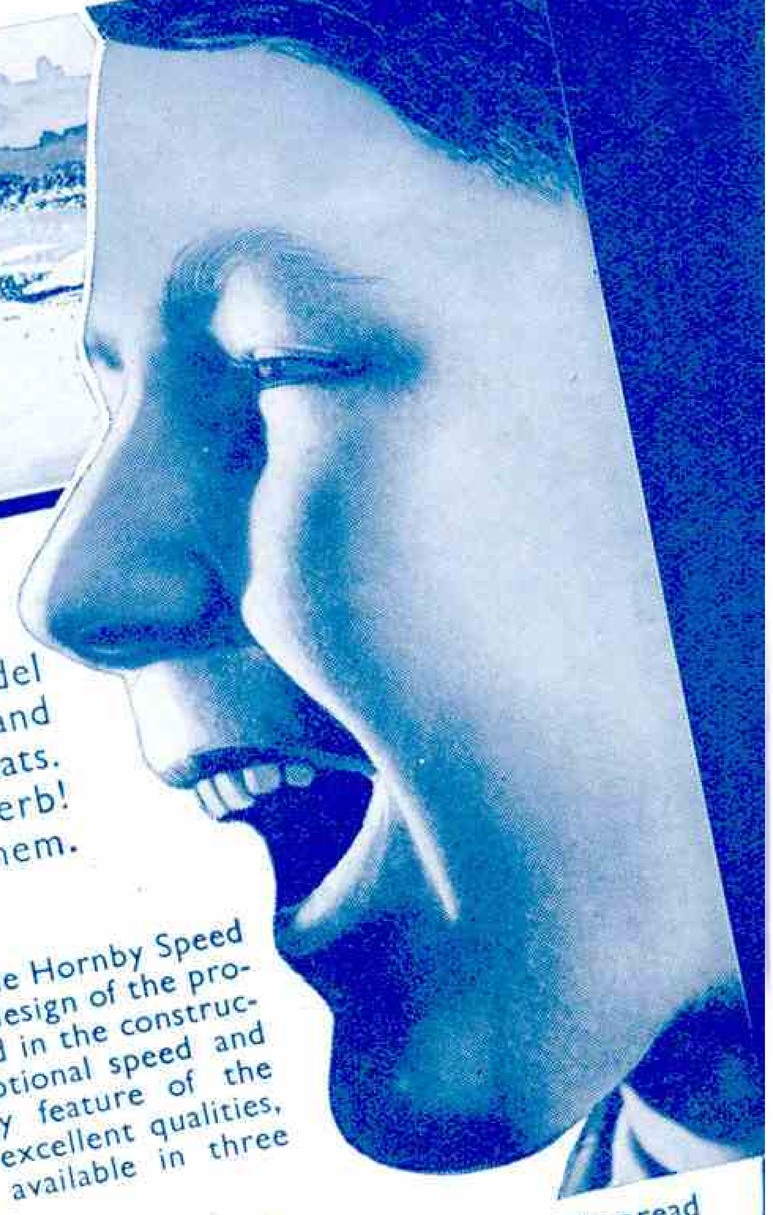

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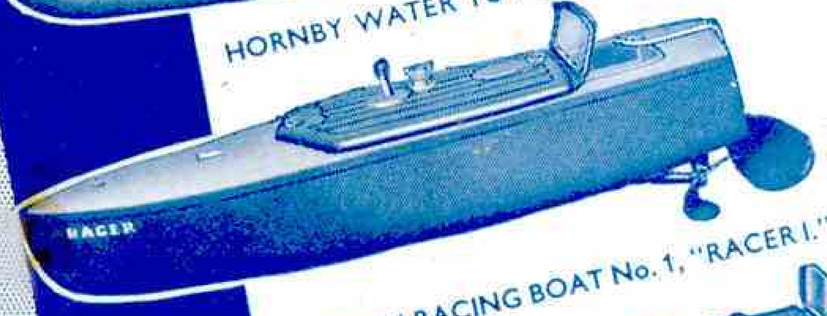

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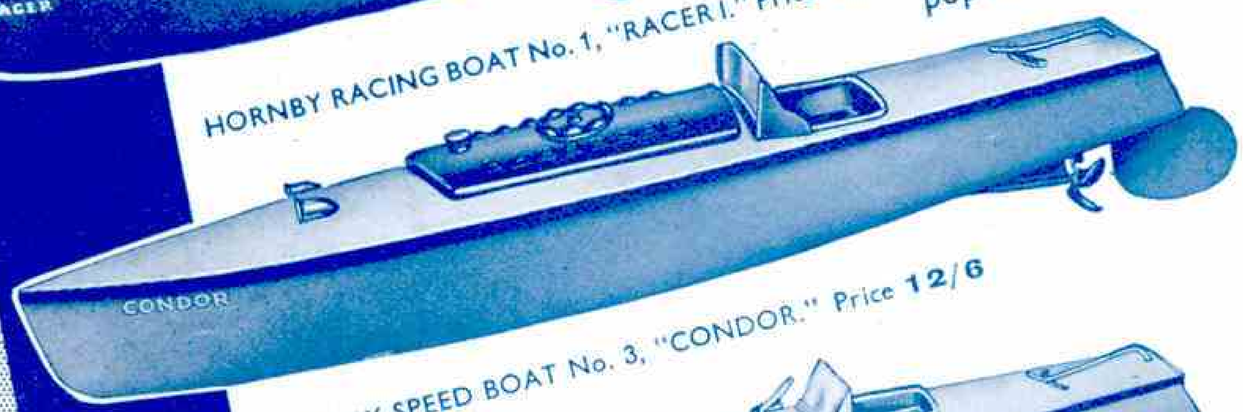

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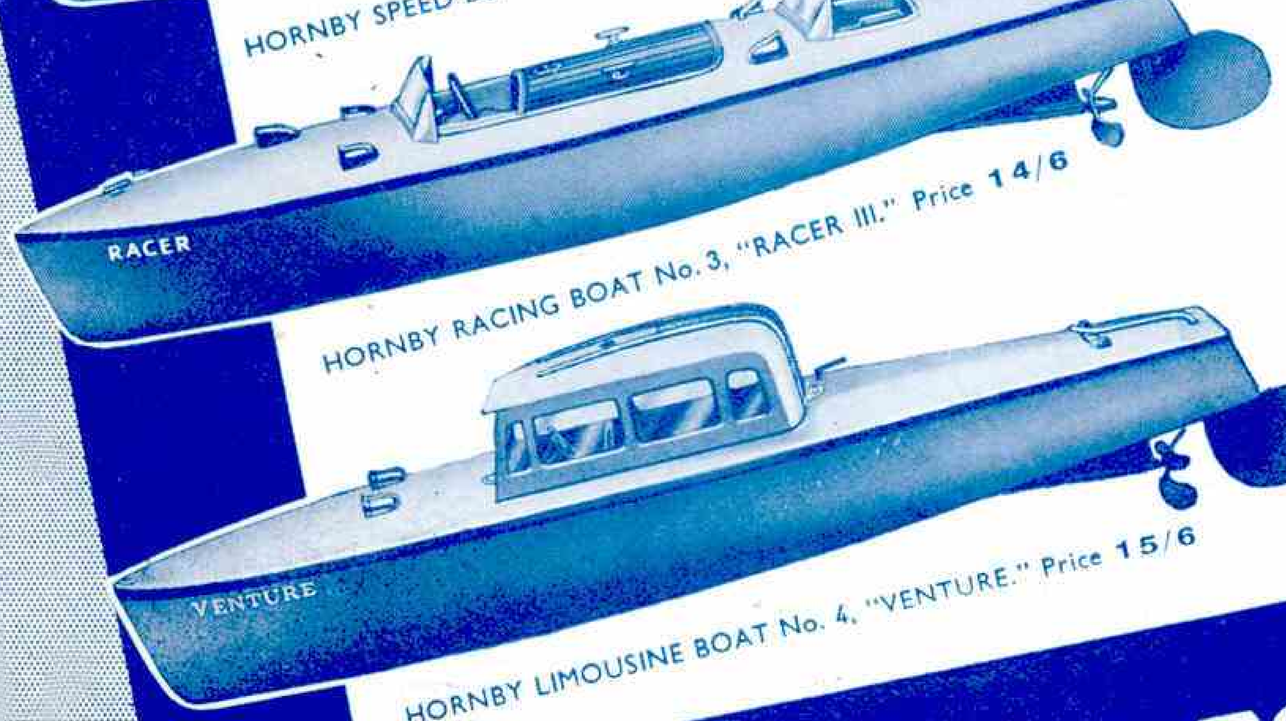

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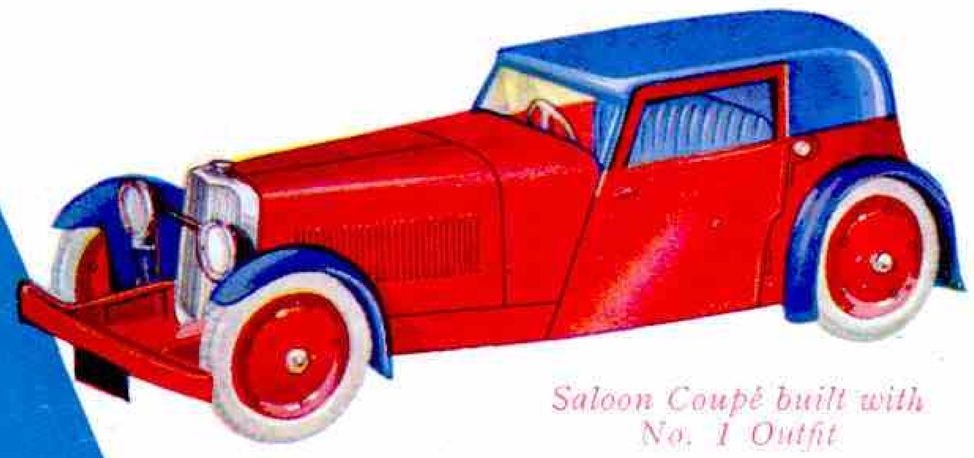
CONSTRUCTOR OUTFITS

Meccauto 588189



Saloon Coupé built with No. 1 Outfit

Build your own Motor Cars!

Now is the time to get a Meccano Motor Car Outfit You will never grow tired of building and running the superb models that you will be able to build. Your days will be full of fun and thrills !

Perfect miniature reproductions of many different types of car can be built with these splendid Outfits, including sports four-seaters, speed cars, sports coupés and others. A powerful clockwork motor, that gives the models a long run on one winding, is included in each Outfit.

The parts are finished in rich enamel and nickel-plate, the complete Outfits being masterpieces of miniature automobile craftsmanship.

Sports Tourer built with No. 1 Outfit

No. 1 Motor Car Constructor Outfit

The motor car models that can be built with this Outfit are the finest you ever saw. Look at the examples shown in the accompanying illustrations and think of the fun you could have building these and other types equally graceful and realistic.

No. 1 Outfit is available in four different colour combinations—Red and Light Blue, Light Blue and Cream, Green and Yellow, and Cream and Red. It is supplied complete with powerful Clockwork Motor. Price **14/6**

PRODUCT of MECCANO LIMITED LIVERPOOL

Choice Range of Colours

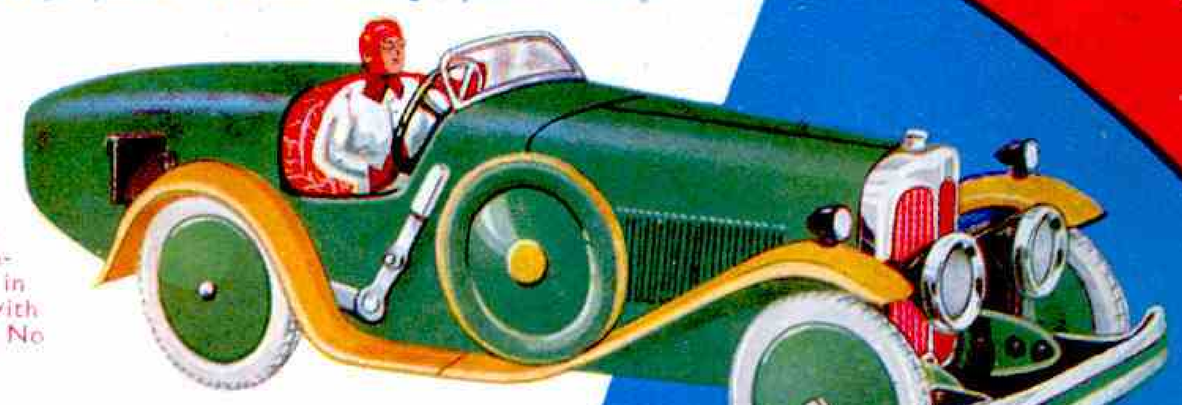
If extra parts in any of the standard colours are required they can be purchased from any Meccano dealer. In addition to the four standard colour combinations, the following parts are available in the colours indicated :—
Body Sections : orange, yellow. Wheels : orange, yellow. Wings : orange, green.

No. 2 Motor Car Constructor Outfit

Larger models of a superior type can be built with No. 2 Outfit. They are perfectly designed, beautifully finished and the most attractive examples of constructional engineering ever produced for the delight of boys. Their handsome and realistic appearance may be judged from the accompanying illustrations.

No. 2 Outfit is available in four different colour combinations—Red and Light Blue, Light Blue and Cream, Green and Yellow, and Cream and Red. A powerful Clockwork Motor that gives a run of 150 feet on one winding is included. Price **25/-**

IMPORTANT. No. 1 Motor Car Outfit parts cannot be used in conjunction with those of the No 2 Outfit.



Sports Tourer built with No. 2 Outfit

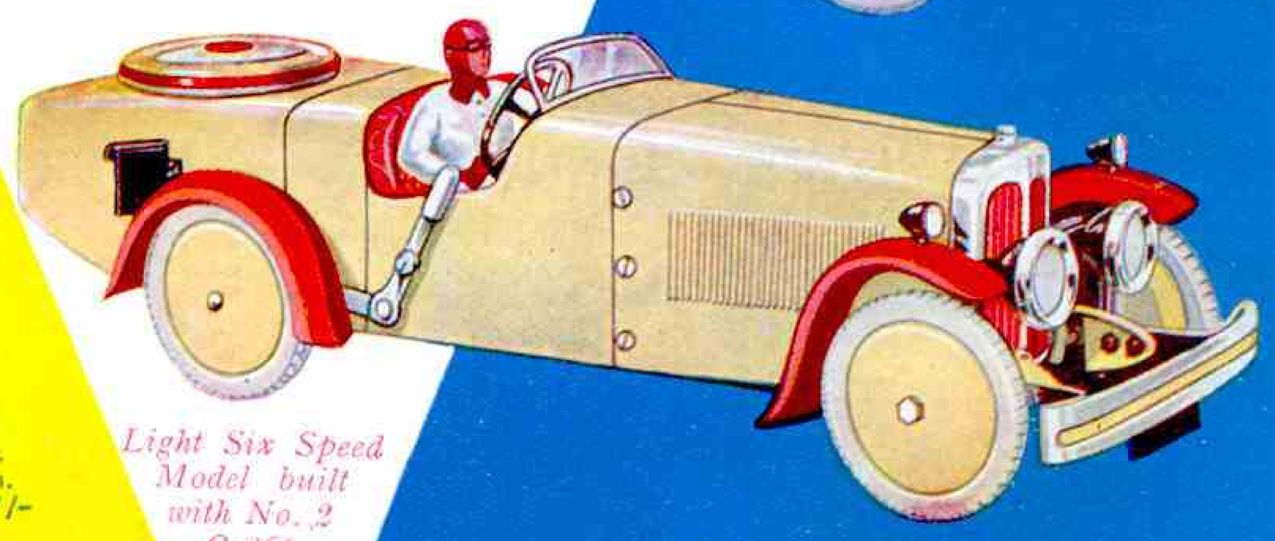
Motor Car Lighting Set

This Lighting Set enables the headlamps of Motor Car models built with the 1933 No. 2 Motor Car Outfit to be electrically lighted Price **2/6**

The Lighting Set contains everything necessary for equipping No. 2 Motor Car models with electric lighting, excepting a dry battery. This should be of the 3-volt type, size 1½in.x 2½in.x⅞in., and may be obtained from any dealer in electrical supplies.

Motor Car Garage

The Meccano Motor Car Garage provides accommodation for any Meccano model motor car or other car of suitable size. Inside dimensions : Height 5 in. Length 13 in. Width 7¾ in. Price **7/-**



Light Six Speed Model built with No. 2 Outfit

Manufactured by

Meccano Ltd., Binns Rd., Liverpool 13

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